NASA/SP—1999-7037/SUPPL397
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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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Typical Report Citation and Abstract

❶ 19970001126 NASA Langley Research Center, Hampton, VA USA
❷ Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10° to 50°, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65° swept forebody serrations tended to roll together, while vortices from 40° swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

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2. Title
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7. Abstract
8. Abstract Author
9. Subject Terms

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 397)

APRIL 2, 1999

01
AERONAUTICS

19990019831 NASA Ames Research Center, Moffett Field, CA USA

HPCCP/CAS Workshop Proceedings 1998

Schulbach, Catherine, NASA Ames Research Center, USA; Mata, Ellen, Editor, Raytheon Co., USA; Schulbach, Catherine, Editor, NASA Ames Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999; 275p; In English; Sponsored by NASA Ames Research Center, USA; See also 19990019832 through 19990019878

Contract(s)/Grant(s): RTOP 509-10-61

Report No.(s): NASA/CP-1999-208757; A-990762; NAS 1.55:208757; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

This publication is a collection of extended abstracts of presentations given at the HPCCP/CAS (High Performance Computing and Communications Program/Computational Aerosciences Project) Workshop held on August 24-26, 1998, at NASA Ames Research Center, Moffett Field, California. The objective of the Workshop was to bring together the aerospace high performance computing community, consisting of airframe and propulsion companies, independent software vendors, university researchers, and government scientists and engineers. The Workshop was sponsored by the HPCCP Office at NASA Ames Research Center. The Workshop consisted of over 40 presentations, including an overview of NASA's High Performance Computing and Communications Program and the Computational Aerosciences Project; ten sessions of papers representative of the high performance computing research conducted within the Program by the aerospace industry, academia, NASA, and other government laboratories; two panel sessions; and a special presentation by Mr. James Bailey.

Author

Computer Programming; Computer Systems Design; Computer Systems Performance; Algorithms; Computer Programs; Parallel Computers; Multidisciplinary Research; Computer Aided Design; Mathematical Programming; Conferences; Aerospace Systems

19990021368 Logistics Management Inst., McLean, VA USA

Aviation System Analysis Capability Quick Response System Report for Fiscal Year 1998 *Final Report, 1998*

Ege, Russell, Logistics Management Inst., USA; Villani, James, Logistics Management Inst., USA; Ritter, Paul, Logistics Management Inst., USA; January 1999; 87p; In English

Contract(s)/Grant(s): NAS2-14961; RTOP 538-16-11-01

Report No.(s): NASA/CR-1999-208990; NAS 1.26:208990; NS801S2; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This document presents the additions and modifications made to the Quick Response System (QRS) in FY 1998 in support of the ASAC QRS development effort. this Document builds upon the Aviation System Analysis Capability Quick Responses System Report for Fiscal Year 1997.

Author

Systems Analysis; Civil Aviation; Air Transportation; Aeronautics; Airline Operations

19990021379 British Columbia Univ., Faculty of Commerce and Business Administration, Vancouver, British Columbia Canada

The Conference Proceedings of the 1997 Air Transport Research Group (ATRG) of the WCTR Society, Volume 1

Oum, Tae Hoon, Editor, British Columbia Univ., Canada; Bowen, Brent D., Editor, British Columbia Univ., Canada; Oct. 1997; 156p; In English; Air Transport Research Group (ATRG) of the WCTR Society, 25-27 Jun. 1997, Vancouver, CA, USA, Held at the Univ. of British Columbia; See also 19990021380 through 19990021388

Contract(s)/Grant(s): NCC5-169

Report No.(s): NASA/CR-1997-208049; NAS 1.26:208049; UNOAI-Rept-97-2; Copyright Waived (NASA); Avail: CASI; A08, Hardcopy; A02, Microfiche

The UNO Aviation Institute has published the 1997 Proceedings of the Air Transport Research Group of the World Conference on Transportation Research (WCTR) Society. Items published in this three volume, seven monograph series were presented at the triennial ATRG Conference held at the University of British Columbia, June 25-27, 1997. A wide variety of policy issues are discussed including the following: open- skies agreements, liberalization, globalization, airline competition, airport performance, pricing, hubs, and safety, among others.

Author

Air Transportation; Policies; Competition; Airline Operations

19990024830 NASA Langley Research Center, Hampton,VA USA

Aeronautical Engineering: A Continuing Bibliography with Indexes, Supplement 395

Mar. 05, 1999; 72p; In English

Report No.(s): NASA/SP-1999-7037/SUPPL395; NAS 1.21:7037/SUPPL395; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report lists reports, articles and other documents recently announced in the NASA STI Database.

Author

Aeronautical Engineering; Bibliographies; Aircraft Design; Aircraft Performance; Aircraft Structures

19990024950 United Technologies Research Center, East Hartford, CT USA

Development of UV Optical Measurements of Nitric Oxide and Hydroxyl Radical at the Exit of High Pressure Gas Turbine Combustors *Final Report, Mar. 1995 - Mar. 1998*

Liscinsky, D. S., United Technologies Research Center, USA; Knight, B. A., United Technologies Research Center, USA; Shirley, J. A., United Technologies Research Center, USA; December 1998; 28p; In English

Contract(s)/Grant(s): NAS3-27593; RTOP 538-08-12

Report No.(s): NASA/CR-1998-208869; E-11498; NAS 1.26:208869; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Measurements of nitric oxide (NO) and hydroxyl radical (OR) have been made in a laboratory flat flame at pressures up to 30 atm using line-of-sight resonant absorption. Data are reported at equivalence ratios of 0.98 and 1.3 and pressures of 1, 5, 10, 20 and 30 atm. The performance of the in-situ UV absorption technique with assessed at these elevated pressures by comparing the measured absorption with those predicted by detailed theoretical spectroscopic models for NO and OH. Previous to this experiment the resonant models had not been verified at pressures greater than two atmospheres. Agreement within 25% was found between the measurements and predictions with only slight modification of the existing models for both NO and OH to account for line center shifting and pressure broadening. Continuum interference of hot oxygen (O2) on the NO absorption spectra was not significant in the interpretation of the data. The optical methods used in this study are distinct from laser-based diagnostics such as laser induced fluorescence and, hence, have the potential to provide independent verification of the laser-based measurements. The methodology is also of sufficient simplicity to be hardened into a portable optical measurement system that can be deployed in gas turbine engine test cells. A miniature fiber optic couple portable instrument is described.

Author

Combustion Chambers; Compressed Gas; Continuums; Gas Turbine Engines; Gas Turbines; Hydroxyl Radicals; Laser Induced Fluorescence; Spectroscopy; Fiber Optics

19990024952 Logistics Management Inst., McLean, VA USA

Modeling Air Traffic Management Technologies with a Queuing Network Model of the National Airspace System *Final Report*

Long, Dou, Logistics Management Inst., USA; Lee, David, Logistics Management Inst., USA; Johnson, Jesse, Logistics Management Inst., USA; Gaier, Eric, Logistics Management Inst., USA; Kostiuk, Peter, Logistics Management Inst., USA; January 1999; 128p; In English

Contract(s)/Grant(s): NAS2-14361; RTOP 538-16-11-01

Report No.(s): NASA/CR-1999-208988; NAS 1.26:208988; NS808S1; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report describes an integrated model of air traffic management (ATM) tools under development in two National Aeronautics and Space Administration (NASA) programs -Terminal Area Productivity (TAP) and Advanced Air Transport Technolo-

gies (AATT). The model is made by adjusting parameters of LMINET, a queuing network model of the National Airspace System (NAS), which the Logistics Management Institute (LMI) developed for NASA. Operating LMINET with models of various combinations of TAP and AATT will give quantitative information about the effects of the tools on operations of the NAS. The costs of delays under different scenarios are calculated. An extension of Air Carrier Investment Model (ACIM) under ASAC developed by the Institute for NASA maps the technologies' impacts on NASA operations into cross-comparable benefits estimates for technologies and sets of technologies.
Author
National Airspace System; Space Programs; Logistics Management; Air Transportation; Air Traffic Control

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

19990019704 Chicago State Univ., Dept. of Mathematics and Computer Science, Chicago, IL USA
Assessment of Turbulent Models for Single-Element Airfoil at High-Lift
Getachew, Dawit, Chicago State Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 62; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The present study consists of: flow calculations around an AEROSPATIALE A-airfoil at high angles of attacks, and assessing different turbulence models by comparing numerically predicted turbulent flow characteristics over the airfoil against reference experimental values. The turbulence models investigated include: (i) the Spalart-Allmaras (SA) one equation mode (ii) the Mentr's k-Omega Shear Stress Transport (MSST) model and (iii) the k - 6 version of the Explicit Algebraic model of Gateski and Spezial with variable (p). To attain this goal, a series of computations, using CFL3Dv5 code of NASA Langley Research Center, have been performed for a M = 0.15, angles of attacks at 3.4, 10.1, 14.1 and 17.1 and Re = 3.13 x 10, as well as a low Reynolds number test case Re = 2 x 10(exp 6) and at incidence a = 13.3. For all the calculations performed in this investigation, the location of transition points on the suction and pressure sides are fixed at 12% and 30% of the chord, respectively, and we used the mandatory structured C-mesh consisting of 512 cells in the wrap-around directions and 128 cells in wall-normal direction. The wake was covered by 64 cells and 384 cells were located on the airfoil surface. The results of this investigation show that the performance of the two linear eddy viscosity models, namely SA and MSST, is the same for most of the test cases considered. Furthermore, for the low Reynolds number test case, these two models did perform better than the nonlinear eddy viscosity model (EASM), whereas for the high Reynolds number test case the EASM perform well. Since the grid independence study, to generate the fine mesh used in the present investigation, was performed using linear eddy viscosity models, it is difficult to draw, using the aforementioned results, any conclusion about the overall performance of EASM as compared to the other two linear eddy viscosity models.
Author
Turbulence Models; Turbulent Flow; Airfoils; Eddy Viscosity; Flow Characteristics; Shear Stress; Stress Analysis

19990019719 Old Dominion Univ., Dept. of Engineering Technology, Norfolk, VA USA
Hyper-X Research Vehicle Stage Separation: Mach 7 Time Accurate Viscous Computations
Moheldin, Taj O., Old Dominion Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 79; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

With the present interest in aerospace planes, considerable effort is being devoted to the development of propulsion systems that would power these vehicles. Among the proposed engine systems, scramjet engine (supersonic combustion ramjet) has been expected to be applied as the propulsion system. NASA's hypersonic technology program Hyper-X, has been initiated to elevate scramjet powered hypersonic technology readiness (TRL's) from the wind tunnel to the real flight environment, the last stage preceding prototype development. The program is now concentrating on Mach 7 vehicle development, verification and validation and flight test risk reduction. The desired test condition for the hyper-X in free flight is a dynamic pressure of 1000 pounds per square foot. The research vehicle will be boosted to approximately 95,000 feet for Mach 7. Following drop from the B-52 and boost to the predetermined stage separation point, the hyper-X research vehicle will be ejected from the booster-stack and start the programmed flight test. The stage separation will resume with the ignition of the explodable rivets fastening the vehicle to the arm. Then the arm will swing down about the hinge connected to the Hyper-X Launch vehicle leaving the research vehicle free and air-borne at the desired flight speed. CFD computations and experimental data with the drop-jaw adaptor at several rota-

tion angles predicted significant interference on the hyper-X research vehicle during stage separation. Several dynamic simulation of hyper-X stage separation have been presented using time accurate inviscid computations. However, an adequate prediction of this unsteady hypersonic flowfield should include viscous effects. The focus of this study is to perform dynamic simulations of hyper-X stage separation to assess viscous effects on the transient forces and moments and to compare with the inviscid results. The unstructured grid solver, Rampant, is used to perform the steady state and time accurate analysis. Results for MACH 7 steady state and time accurate inviscid and viscous computations with fixed 0.5 inch cavity openings are presented in this study.

Author

Hypersonic Speed; Hypersonics; Research Aircraft; Aerospace Planes; Launch Vehicles; Mach Number; Propulsion System Configurations; Propulsion System Performance

19990019869 **NASA Ames Research Center, Moffett Field, CA USA**

Aerodynamic Shape Optimization Using A Combined Distributed/Shared Memory Paradigm

Cheung, Samson, MRJ Technology Solutions, USA; Holst, Terry, NASA Ames Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 207-212; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Current parallel computational approaches involve distributed and shared memory paradigms. In the distributed memory paradigm, each processor has its own independent memory. Message passing typically uses a function library such as MPI or PVM. In the shared memory paradigm, such as that used on the SGI Origin 2000 machine, compiler directives are used to instruct the compiler to schedule multiple threads to perform calculations. In this paradigm, it must be assured that processors (threads) do not simultaneously access regions of memory in such away that errors would occur. This paper utilizes the latest version of the SGI MPI function library to combine the two parallelization paradigms to perform aerodynamic shape optimization of a generic wing/body.

Author

Distributed Memory; Interprocessor Communication; Optimization; Newton Methods; Parallel Processing (Computers); Aircraft Design

19990019870 **National Academy of Sciences - National Research Council, Hampton, VA USA**

High-Fidelity Analysis and Aerodynamic Optimization of a Supersonic Transport

Giunta, Anthony A., National Academy of Sciences - National Research Council, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 213-218; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

A suite of modular government/commercial off-the-shelf (G/COTS) software packages has been created to perform high-fidelity aeroelastic analysis and aerodynamic optimization of aircraft configurations. While the current status of the software permits multidisciplinary analysis and single-disciplinary optimization, the goal of this research is to develop a high-fidelity multidisciplinary optimization (MDO) capability in which various MDO methods will be examined on realistic aircraft design problems. The existing MPI-based parallel computing capability in some elements of the G/COTS software is a key component in realizing the goal of high-fidelity MDO. In particular, the parallel computing capabilities allow the efficient calculation of sensitivity derivatives needed to perform gradient-based optimization. to demonstrate the utility of this modular G/COTS software approach, an aeroelastic analysis and aerodynamic optimization of a high-speed civil transport (HSCT) are examined.

Author

Aerodynamic Configurations; Applications Programs (Computers); Multidisciplinary Design Optimization; Aeroelasticity; Parallel Processing (Computers); Design Analysis

19990019871 **NASA Langley Research Center, Hampton, VA USA**

Parallel Computation of Sensitivity Derivatives with Application to Aerodynamic Optimization of a Wing

Biedron, Robert T., NASA Langley Research Center, USA; Samareh, Jamshid A., NASA Langley Research Center, USA; Green, Lawrence T., NASA Langley Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 219-224; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper focuses on the parallel computation of aerodynamic derivatives via automatic differentiation of the Euler/Navier-Stokes solver CFL3D. The comparison with derivatives obtained by finite differences is presented and the scaling of the time required to obtain the derivatives relative to the number of processors employed for the computation is shown. Finally, the deriva-

tive computations are coupled with an optimizer and surface/volume grid deformation tools to perform an optimization to reduce the drag of a three-dimensional wing.
Author
Parallel Processing (Computers); Applications Programs (Computers); Computation; Optimization; Wing Profiles; Differentiation; Parameterization

19990019872 NASA Langley Research Center, Hampton, VA USA
Demonstration of Automatically-Generated Adjoint Code for Use in Aerodynamic Shape Optimization
Green, Lawrence, NASA Langley Research Center, USA; Carle, Alan, Rice Univ., USA; Fagan, Mike, Rice Univ., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 225-229; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Gradient-based optimization requires accurate derivatives of the objective function and constraints. These gradients may have previously been obtained by manual differentiation of analysis codes, symbolic manipulators, finite-difference approximations, or existing automatic differentiation (AD) tools such as ADIFOR (Automatic Differentiation in FORTRAN). Each of these methods has certain deficiencies, particularly when applied to complex, coupled analyses with many design variables. Recently, a new AD tool called ADJIFOR (Automatic Adjoint Generation in FORTRAN), based upon ADIFOR, was developed and demonstrated. Whereas ADIFOR implements forward mode (direct) differentiation throughout an analysis program to obtain exact derivatives via the chain rule of calculus, ADJIFOR implements the reverse-mode counterpart of the chain rule to obtain exact adjoint form derivatives from FORTRAN code. Automatically-generated adjoint versions of the widely-used CFL3D computational fluid dynamics (CFD) code and an algebraic wing grid generation code were obtained with just a few hours processing time using the ADJIFOR tool. The codes were verified for accuracy and were shown to compute the exact gradient of the wing lift-to-drag ratio, with respect to any number of shape parameters, in about the time required for 7 to 20 function evaluations. The codes have now been executed on various computers with typical memory and disk space for problems with up to 129 x 65 x 33 grid points, and for hundreds to thousands of independent variables. These adjoint codes are now used in a gradient-based aerodynamic shape optimization problem for a swept, tapered wing. For each design iteration, the optimization package constructs an approximate, linear optimization problem, based upon the current objective function, constraints, and gradient values. The optimizer subroutines are called within a design loop employing the approximate linear problem until an optimum shape is found, the design loop limit is reached, or no further design improvement is possible due to active design variable bounds and/or constraints. The resulting shape parameters are then used by the grid generation code to define a new wing surface and computational grid. The lift-to-drag ratio and its gradient are computed for the new design by the automatically-generated adjoint codes. Several optimization iterations may be required to find an optimum wing shape. Results from two sample cases will be discussed. The reader should note that this work primarily represents a demonstration of use of automatically- generated adjoint code within an aerodynamic shape optimization. As such, little significance is placed upon the actual optimization results, relative to the method for obtaining the results.
Derived from text
Applications Programs (Computers); Aerodynamic Configurations; Shape Functions; Optimization; Grid Generation (Mathematics); Differential Calculus; Aircraft Design; Computer Techniques

19990019873 Boeing Co., Long Beach, CA USA
Applications of Parallel Processing in Aerodynamic Analysis and Design
Sundaram, P., Boeing Co., USA; Hager, James O., Boeing Co., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 231-237; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The continuously growing size and computational complexity of CFD-based aerodynamic analysis problems demand larger and larger computational resources. In addition, quick turn-around time for design and synthesis are necessary to make high fidelity, CFD-based techniques practical. Typical full-configuration, Navier-Stokes analysis grids tend to have more than 10 million points, and the solutions to these problems require very large amounts of CPU time and memory. Also, CFD-based nonlinear shape optimization of full aircraft configurations is required within a few weeks to meet the cost and schedule challenges of today's aerospace customer. Traditional sequential computers cannot deliver these large computing resources, and no new large sequential vector supercomputers are under development. Thus, parallel processing has emerged as the most efficient and cost-effective method to achieve the large computational resources required for these advanced CFD applications. This paper presents the recent progress made in the application of the CFL3Dhp parallel code for configuration analyses and aerodynamic shape optimization at Boeing-Phantom Works (BPW). CFL3Dhp is the coarse-grain parallel version of the CFL3D Euler/Navier-Stokes solver developed at NASA LARC. CFL3Dhp utilizes the MPI message-passing library to exchange information with other task processors

as well as with the host. CFL3Dhp runs on most available parallel platforms and distributed environments. Several utilities have been developed at BPW to provide a user-friendly parallel environment.
Author
Parallel Processing (Computers); Aerodynamic Configurations; Aerodynamics; Aircraft Design; Applications Programs (Computers); Optimization; Design Analysis

19990020957 NASA Langley Research Center, Hampton,VA USA
Effects of Convoluted Divergent Flap Contouring on the Performance of a Fixed-Geometry Nonaxisymmetric Exhaust Nozzle
Asbury, Scott C., NASA Langley Research Center, USA; Hunter, Craig A., NASA Langley Research Center, USA; Feb. 1999; 75p; In English
Contract(s)/Grant(s): RTOP 538-14-12-01
Report No.(s): NASA/TP-1999-209093; L-17696; NAS 1.60:209093; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An investigation was conducted in the model preparation area of the Langley 16-Foot Transonic Tunnel to determine the effects of convoluted divergent-flap contouring on the internal performance of a fixed-geometry, nonaxisymmetric, convergent-divergent exhaust nozzle. Testing was conducted at static conditions using a sub-scale nozzle model with one baseline and four convoluted configurations. All tests were conducted with no external flow at nozzle pressure ratios from 1.25 to approximately 9.50. Results indicate that baseline nozzle performance was dominated by unstable, shock-induced, boundary-layer separation at overexpanded conditions. Convoluted configurations were found to significantly reduce, and in some cases totally alleviate separation at overexpanded conditions. This result was attributed to the ability of convoluted contouring to energize and improve the condition of the nozzle boundary layer. Separation alleviation offers potential for installed nozzle aeropropulsive (thrust-minus-drag) performance benefits by reducing drag at forward flight speeds, even though this may reduce nozzle thrust ratio as much as 6.4% at off-design conditions. At on-design conditions, nozzle thrust ratio for the convoluted configurations ranged from 1% to 2.9% below the baseline configuration; this was a result of increased skin friction and oblique shock losses inside the nozzle.
Author
Convergent-Divergent Nozzles; Boundary Layer Separation; Wind Tunnel Nozzles; Wind Tunnel Tests; Nozzle Flow; Oblique Shock Waves; Flow Visualization

19990021182 Air Univ., Maxwell AFB, AL USA
The Development of Military Night Aviation to 1919
Fischer, William E., Jr, Air Univ., USA; Dec. 1998; 169p; In English
Report No.(s): AD-A358599; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This study examines the development of military night aviation from its origins through the First World War. Emphasis is on the evolution of night flying in those countries which fought on the Western Front, namely France, Germany, Great Britain, and the USA. While night flying occurred In other theaters, the most intense air effort was clearly in the west. There, belligerents pressed aviation technology and tactics to the limits; the skies of northern France and Flanders offered the only opportunity for movement across the stagnated front. Another important consideration was the availability of rich documentation concerning night aerial activity in the theater. To appreciate the rapid development of night military aviation during the First World War, one first needs to understand the state of night flying prior to August 1914. Numerous aeronautical Journals of the period offer articles exploring the technical problems associated with night flight. Additionally the New York Times provides a useful but more general day-to-day accouat of the evolution of flying during darkness. Source material for the war period is quite extensive.
DTIC
Night Flights (Aircraft); Military Aviation

19990021235 DYNACS Engineering Co., Inc., Brook Park, OH USA
Validation Results for LEWICE 2.0 *Final Report*
Wright, William B., DYNACS Engineering Co., Inc., USA; Rutkowski, Adam, Case Western Reserve Univ., USA; January 1999; 679p; In English
Contract(s)/Grant(s): NAS3-98022; RTOP 548-20-23
Report No.(s): NASA/CR-1999-208690; E-11479; NAS 1.26:208690; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

A research project is underway at NASA Lewis to produce a computer code which can accurately predict ice growth under any meteorological conditions for any aircraft surface. This report will present results from version 2.0 of this code, which is called

LEWICE. This version differs from previous releases due to its robustness and its ability to reproduce results accurately for different spacing and time step criteria across computing platform. It also differs in the extensive amount of effort undertaken to compare the results in a quantified manner against the database of ice shapes which have been generated in the NASA Lewis Icing Research Tunnel (IRT). The results of the shape comparisons are analyzed to determine the range of meteorological conditions under which LEWICE 2.0 is within the experimental repeatability. This comparison shows that the average variation of LEWICE 2.0 from the experimental data is 7.2% while the overall variability of the experimental data is 2.5%.
Author
Computer Programs; Ice Formation; Variability; Data Bases

19990021363 **Kentucky Univ., Dept. of Mechanical Engineering, Lexington, KY USA**
Shared Memory Parallelization of an Implicit ADI-type CFD Code *Final Report*
Hauser, Th., Kentucky Univ., USA; Huang, P. G., Kentucky Univ., USA; Feb. 1999; 29p; In English
Contract(s)/Grant(s): NAG3-2099; RTOP 523-90-13
Report No.(s): NASA/CR-1999-208688; E-11472; NAS 1.26:208688; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A parallelization study designed for ADI-type algorithms is presented using the OpenMP specification for shared-memory multiprocessor programming. Details of optimizations specifically addressed to cache-based computer architectures are described and performance measurements for the single and multiprocessor implementation are summarized. The paper demonstrates that optimization of memory access on a cache-based computer architecture controls the performance of the computational algorithm. A hybrid MPI/OpenMP approach is proposed for clusters of shared memory machines to further enhance the parallel performance. The method is applied to develop a new LES/DNS code, named LESTool. A preliminary DNS calculation of a fully developed channel flow at a Reynolds number of 180, Re(sub tau) = 180, has shown good agreement with existing data.
Author
Multiprocessing (Computers); Parallel Processing (Computers); Memory (Computers); Computer Programs; Parallel Programming

19990023294 **Norwegian Defence Research Establishment, Kjeller, Norway**
Development of AV 6-DOF Projectile Trajectory Model *Utvikling an EN 6-Dof Flukt simulator for Pilprosjektiler*
Oyvind, Grandum, Norwegian Defence Research Establishment, Norway; Oct. 01, 1998; 21p; In Norwegian
Contract(s)/Grant(s): Proj. FFIVM/748/130
Report No.(s): FFI/RAPPORT-98/04903; ISBN 82-464-0305-2; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A 6 degrees-of-freedom trajectory model for symmetric projectiles has been developed. The aim has been a model for kinetic energy weapons, but can also be used for spin stabilized projectiles. The model is implemented in C++ and compiles on both PC and workstations. The program is run in two modi: 1) Direct firing mode with given azimuth and elevation, or 2) Iterative mode which finds the necessary azimuth and elevation given the position of the target. The program takes into account wind, varying atmosphere and Coriolis acceleration. The input format is based upon the NATO Ballistic Kernel standard. Graphical postprocessing is available on UNIX machines with the gnuplot plotting software. The plan is to extend the graphical capabilites to Windows-based PCs.
Author
Mathematical Models; Projectiles; Ballistic Trajectories; Trajectory Analysis; Computerized Simulation; Equations of Motion; Ballistics; Applications Programs (Computers)

19990024902 **Beijing Univ. of Aeronautics and Astronautics, Dept. of Flight Vehicle Design and Applied Mechanics, Beijing, China**
Reviews and prospects in turbulent drag reduction over riblets surface
Jinjun, Wang, Beijing Univ. of Aeronautics and Astronautics, China; Journal of Beijing University of Aeronautics and Astronautics; February 1998; ISSN 1001-5965; Volume 24, No. 1, pp. 31-34; In Chinese; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The experimental investigations of turbulent boundary layer flow, turbulent coherent structures, turbulent drag reduction and its mechanism have been reviewed. The experimental velocities cover subsonic, transonic and supersonic flows, and the content includes (1) flow over flat plate, revolution body and wing with riblets surface at zero angle of attack; (2) the effect of pressure gradient, angle of attack and slide angle; (3) the burst characteristics, characteristics of turbulence, the streak structure in the near wall region and the drag reduction mechanism. In order to reduce the skin friction efficiently, more research work should be done

on the characteristics of turbulent boundary layer, turbulent coherent structures and the mechanism of turbulent drag reduction for flow over riblets surfaces.
Author
Turbulent Boundary Layer; Drag Reduction; Riblets; Turbulent Flow; Pressure Effects; Boundary Layer Flow; Aerodynamic Drag

19990024922 NASA Langley Research Center, Hampton, VA USA
Extrapolation From Wind Tunnel to Flight: Shuttle Orbiter Aerodynamics
Muylaert, J., European Space Agency. European Space Research and Technology Center, ESTEC, Netherlands; Walpot, L., European Space Agency. European Space Research and Technology Center, ESTEC, Netherlands; Rostand, P., Dassault Aviation, France; Rapuc, M., Dassault Aviation, France; Brauckmann, G., NASA Langley Research Center, USA; Paulson, J., NASA Langley Research Center, USA; Trockmorton, D., NASA Langley Research Center, USA; Weilmuenster, K., NASA Langley Research Center, USA; Hypersonic Experimental and Computational Capability, Improvement and Validation; December 1998; Volume 2; 15p; In English; See also 19990024917; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

The paper reviews a combined numerical and experimental activity on the Shuttle Orbiter, first performed at NASA Langley within the Orbiter Experiment (OEX) and subsequently at ESA, as part of the AGARD FDP WG 18 activities. The study at Langley was undertaken to resolve the pitch up anomaly observed during the entry of the first flight of the Shuttle Orbiter. The present paper will focus on real gas effects on aerodynamics and not on heating. The facilities used at NASA Langley were the 15-in. Mach 6, the 20-in. Mach 6, the 31-in. Mach 10 and the 20-in. Mach 6 CF4 facility. The paper focuses on the high Mach, high altitude portion of the first entry of the Shuttle where the vehicle exhibited a nose-up pitching moment relative to pre-flight prediction of (Delta C(sub m)) = 0.03. In order to study the relative contribution of compressibility, viscous interaction and real gas effects on basic body pitching moment and flap efficiency, an experimental study was undertaken to examine the effects of Mach, Reynolds and ratio of specific heats at NASA. At high Mach, a decrease of gamma occurs in the shock layer due to high temperature effects. The primary effect of this lower specific heat ratio is a decrease of the pressure on the aft windward expansion surface of the Orbiter causing the nose-up pitching moment. Testing in the heavy gas, Mach 6 CF4 tunnel, gave a good simulation of high temperature effects. The facilities used at ESA were the lm Mach 10 at ONERA Modane, the 0.7 m hot shot F4 at ONERA Le Fauga and the 0.88 m piston driven shock tube HEG at DLR Goettingen. Encouraging good force measurements were obtained in the F4 facility on the Orbiter configuration. Testing of the same model in the perfect gas Mach 10 S4 Modane facility was performed so as to have "reference" conditions. When one compares the F4 and S4 test results, the data suggests that the Orbiter "pitch up" is due to real gas effects. In addition, pressure measurements, performed on the aft portion of the windward side of the Halis configuration in HEG and F4, confirm that the pitch up is mainly attributed to a reduction of pressure due to a local decrease in gamma.
Author
Mach Number; Pitching Moments; Real Gases; Laminar Flow; Wind Tunnel Tests; Reynolds Number; Hypersonic Flow; Oxygen; Computational Fluid Dynamics; Nitrogen

19990024923 NASA Ames Research Center, Moffett Field, CA USA
Real-Gas Aerothermodynamics Test Facilities
Arnold, James O., NASA Ames Research Center, USA; Seibert, George L., Wright Lab., USA; Wendt, John F., Von Karman Inst. for Fluid Dynamics, Belgium; Hypersonic Experimental and Computational Capability, Improvement and Validation; December 1998; Volume 2; 29p; In English; See also 19990024917; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

This chapter provides an overview of the current ground-based aerothermodynamic testing capabilities in Western Europe and the USA. The focus is on facilities capable of producing real-gas effects (dissociation, ionization, and thermochemical nonequilibrium) pertinent to the study of atmospheric flight in the Mach number range of 5 less than M less than 50. Perceived mission needs of interest to the Americans and Western Europeans are described where such real-gas flows are important. The role of Computational Fluid Dynamics (CFD) in modern ground testing is discussed, and the capabilities of selected American and European real-gas facilities are described. An update on the current instrumentation in aerothermodynamic testing is also outlined. Comments are made regarding the use of new facilities which have been brought on line during the past 3-5 years. Finally, future needs for aerothermodynamic testing, including instrumentation, are discussed and recommendations for implementation are reported.
Derived from text
Computational Fluid Dynamics; Ground Tests; Real Gases; Test Facilities; Wind Tunnels; Ballistic Ranges; Shock Tunnels

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

19990019696 Pittsburgh State Univ., Dept. of Engineering Technology, KS USA

Engineering Study for Reactivation of a Six Degrees of Freedom Platform for Aeronautical Safety Investigations

Buchanan, Randy K., Pittsburgh State Univ., USA; Lookadoo, James A., Pittsburgh State Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 52; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The Systems Integration Branch of the Flight Electronics Technology Division at NASA/Langley Research Center possesses a hydraulically operated six degrees of freedom (Stewart) platform that had previously supported microgravity robotics investigations. New directions for NASA's Aeronautical enterprise are driving new initiatives throughout Langley. Future branch operations may incorporate a variety of aeronautical safety investigations. This expectation generated the need to reengineer the platform as a test bed for new experiments. Suitability issues extend beyond the inherent physical and performance parameters of the platform. These operational characteristics were found to be adequate for most of the new testing regimens envisioned. The problem investigated also had constraints in economics and maintainability characteristics. In the leaner budget environment, the platform must not prove too costly to operate or to upgrade. Finally, a wider customer base of users beyond the Systems Integration Branch is anticipated. The facility must incorporate a researcher-friendly interface for these potential new users. Meeting all of the constraints for the problem indicated a solution saving 0 of the current actuator and sensor elements on the platform. Additionally, most of the existing control hardware and control software elements were identified as replaceable with newer and more robust solutions. Meeting the economic guidelines suggested a Pentium grade of PC with appropriate I/0 enhancements as the optimal controls environment for a refurbished platform. This machine would host any necessary kinematics calculations, control algorithms, experiment stimulus generation and resident safety monitoring software elements. Additionally, network capability would allow the platform control PC to support either local or remote computing facilities operating as research interfaces. These ancillary machines would also host the instrumentation systems supporting the experiments mounted on the platform. The final recommendation actually contains a set of potential but workable solutions for implementation. In this fashion, a wider set of experiments and customers may be accommodated.

Author

Degrees of Freedom; Robotics; Kinematics; Computer Programs; Systems Integration; Computers; Economics

19990020984 Federal Aviation Administration, Washington, DC USA

Notices to Airmen Domestic/International, December 3, 1998

1998; 192p; In English

Report No.(s): PB99-118978; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

Table of Contents: Airway Notams; Airports, Facilities, and Procedural Notams; General FDC Notams; Part 95 Revisions to Minimum En Route IFR Altitudes and Changeover Points; International Notices to Airmen; and Graphic Notices.

NTIS

National Airspace System; Air Navigation

19990021337 NASA Lewis Research Center, Cleveland, OH USA

In-Flight Aerodynamic Measurements of an Iced Horizontal Tailplane

Ratvasky, Thomas P., NASA Lewis Research Center, USA; VanZante, Judith Foss, DYNACS Engineering Co., Inc., USA; Jan. 1999; 12p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 548-21-23

Report No.(s): NASA/TM-1999-208902; E-11503; NAS 1.15:208902; AIAA Paper 99-0638; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The effects of tailplane icing on aircraft dynamics and tailplane aerodynamics were investigated using, NASA's modified DHC-6 Twin Otter icing research aircraft. This flight program was a major element of the four-year NASA/FAA research program that also included icing wind tunnel testing, dry-air aerodynamic wind tunnel testing, and analytical code development. Flight tests were conducted to obtain aircraft dynamics and tailplane aerodynamics of the DHC-6 with four tailplane leading-edge configurations. These configurations included a clean (baseline) and three different artificial ice shapes. Quasi-steady and various dynamic flight maneuvers were performed over the full range of angles of attack and wing flap settings with each iced tailplane configuration. This paper presents results from the quasi-steady state flight conditions and describes the range of flow fields at the horizontal

tailplane, the aeroperformance effect of various ice shapes on tailplane lift and elevator hinge moment, and suggests three paths that can lead toward ice-contaminated tailplane stall. It was found that wing, flap deflection was the most significant factor in driving the tailplane angle of attack toward alphatail stall). However, within a given flap setting, an increase in airspeed also drove the tailplane angle of attack toward alphattail stall). Moreover, increasing engine thrust setting also pushed the tailplane to critical performance limits, which resulted in premature tailplane stall.
Author
Aerodynamic Characteristics; Horizontal Tail Surfaces; Flight Characteristics; Aerodynamics; Wind Tunnel Tests; Aircraft Icing

19990021380 Air Canada, Montreal, Quebec Canada
Air Canada and the Canada-US open skies. Agreement of Feb. 24, 1995: A good story .....
The Conference Proceedings of the 1997 Air Transport Research Group (ATRG) of the WCTR Society; Oct. 1997; Volume 1, No. 1; 12p; In English; See also 19990021379; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A02, Microfiche

Air Canada, prior to the U.S. Open Skies Treaty had nine scheduled destinations, 5 scheduled destinations were served by wholly owned regional airlines, 7 additional destinations were served on a seasonal basis by as charters. After the treaty, Air Canada expanded the transborder routes to 24 cites with "own aircraft". Seven of these were conversions of charters into scheduled airlines, and 5 were introduced by Air Canada's regional airlines. An alliance with United Airlines further expanded Air Canada's access to the United States with 50 additional cities. Air Canada has been very effective in penetrating the U.S. interior due to the strength of its Toronto Hub, and its alliance with United Airlines. This document is in viewgraph format
CASI
Airline Operations; Civil Aviation; Routes

19990021381 Japan Air Lines Co. Ltd., Tokyo, Japan
Initiatives for liberalization Asia-Pacific aviation
Nagata, Koki, Japan Air Lines Co. Ltd., Japan; The Conference Proceedings of the 1997 Air Transport Research Group (ATRG) of the WCTR Society; Oct. 1997; Volume 1, No. 1; 14p; In English; See also 19990021379; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A02, Microfiche

An overview is presented of how Japan Airlines sees the current state of US/Japanese aviation relations in the light of the current "Open Skies" policy of the USA with regard to Asia. Some of the problems which the Japanese Airlines have are limitations in "Take Beyond Rights", and U.S. airlines control of one third of all weekly slots at Narita Airport, Japan's major gateway. The paper urges liberalization of restrictions which limit international airlines and proposes two models to such liberalization: (1) the International Civil Aviation Organization (ICAO), and (2) Regional approaches such as the development in the European Union. The Asian region has been pursuing a regional approach since a 1996 meeting in Kyoto, Japan.
CASI
Airline Operations; Airports; Civil Aviation; Policies; Japan

19990021382 Malaysia Airlines, Kuala Lumpur, Malaysia
Initiatives for liberalizing Asia-Pacific aviation: Where do we go from here
Khera, Gernal Singh, Malaysia Airlines, Malaysia; The Conference Proceedings of the 1997 Air Transport Research Group (ATRG) of the WCTR Society; Oct. 1997; Volume 1, No. 1; 10p; In English; See also 19990021379; Copyright Waived (NASA); Avail: CASI; A02, Hardcopy; A02, Microfiche

International air transport is a vibrant, high technology and capital intensive industry which has grown and expanded rapidly for the past fifty years within a well defined legal, economic, regulatory and institutional framework set down in the Convention on !nterantional Civil Aviation (the Chicago Convention.) There are approximately three thousand biilateral air transport agreements which serve reasonalby well in facilitating growth and liberalization of the international air services. The Asia-Pacific region's aviation industry is expecting growth. It is expected that the competitive self interest of privatized carriers will influence government policy for further liberalization within the region. Another factor for liberalization is the economic interest of countries within the region. Several factors may slow the pace of liberalization of the aviation industry in Asia. (1) Economic, Political, Legal developments, and the wide gap between the different countries in the region. (2) Airports in Asia face congestion, and other development problems. (3) State owned carriers, may continue to seek protection for their share of the market.
CASI
Air Transportation; Civil Aviation; International Cooperation; Asia

19990021383 Dubuque Univ., Dubuque, IA USA

British airways/USAir merger: Financial and traffic analysis

Abraham, Edward H., Dubuque Univ., USA; The Conference Proceedings of the 1997 Air Transport Research Group (ATRG) of the WCTR Society; Oct. 1997; Volume 1, No. 1; 16p; In English; See also 19990021379; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A02, Microfiche

By late March 1993, the US Department of Transportation (DOT) and the Justice Department agreed to allow British Airways to purchase a 25 percent equity interest in USAir, with a 21 percent voting interest and code-sharing rights. This paper reviews the history and background of the involved carriers, rationale of mergers, and the consequences of airline mergers and alliances. Part two of this paper evaluates pre- and post-alliance traffic statistics and financial performance in great details. This study examines the relative changes in traffic and profits on British Airways and USAir Group, Inc. Despite the consumer-led recession in 1988 and other social factors, it was found, subjectively, that USAir's management achieved a successful implementation of the cost reduction program announced in late 1991, a new labor agreement were reached with major organized employee groups, and a significant accomplishment in reducing expenditure. The alliance between USAir and British Airways offered travelers the most benefits of any global airline partnership.

Author

Airline Operations; Economic Factors; Air Transportation; Civil Aviation

19990021384 Embry-Riddle Aeronautical Univ., Business Administration Dept., Daytona Beach, FL USA

A typology of strategic alliances in the airline industry: Propositions for stability and duration

Rhoades, Dawna L., Embry-Riddle Aeronautical Univ., USA; Lush, Heather, Embry-Riddle Aeronautical Univ., USA; The Conference Proceedings of the 1997 Air Transport Research Group (ATRG) of the WCTR Society; Oct. 1997; Volume 1, No. 1; 20p; In English; See also 19990021379; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A02, Microfiche

While strategic alliances have become commonplace in the airline industry, the stability and performance of these alliances remains questionable. In this article, the authors review the structure of recent alliances in the airline industry and propose a typology of alliances based on two key dimensions: (1) commitment of resources and (2) complexity of arrangement. Using this typology, the authors derive a series of propositions on the stability and duration of various types of alliances.

Author

Airline Operations; Civil Aviation; Air Transportation; Economics

19990021385 New York Univ., Dept. of International Business, New York, NY USA

The effect of strategic alliance on performance: A study of international airline industry

Park, Namgyoo, New York Univ., USA; Cho, Dong-Sung, Seoul National Univ., Korea, Republic of; The Conference Proceedings of the 1997 Air Transport Research Group (ATRG) of the WCTR Society; Oct. 1997; Volume 1, No. 1; 31p; In English; See also 19990021379; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A02, Microfiche

This study investigates codesharing alliances to see if they increase market shares of the carriers involved by analyzing a time-series data of fifty six airlines over the 1986-93 period. Our empirical results indicate: (1) codesharing, in fact, increases the carriers' market shares; (2) codesharings between existing airlines increase market shares less than those between relatively new carriers; and (3) the market-share-increasing effect of codesharing alliance is higher in markets with fewer competing carriers.

Author

Airline Operations; Civil Aviation; Agreements

19990021386 Seattle Univ., Albers School of Business and Economics, WA USA

Towards an international open skies regime: Advances, impediments, and impacts

Toh, Rex S., Seattle Univ., USA; The Conference Proceedings of the 1997 Air Transport Research Group (ATRG) of the WCTR Society; Oct. 1997; Volume 1, No. 1; 1p; In English; See also 19990021379; Copyright Waived (NASA); Avail: CASI; A01, Hardcopy; A02, Microfiche

The International Air Transportation Competition Act of 1979 heralded the era of Open Skies in international aviation. This paper traces the post-war regulation and then deregulation of fares, rates, routes, and capacity all the way from Bermuda I through the partial dismantling of the IATA price fixing apparatus, discusses the impediments to Open Skies, and examines the impact on the International Air Transport Association (IATA).

Derived from text

Air Transportation; Competition; Routes; International Relations; Agreements

19990021387 Kaduck (Raymon J.), Yellowknife, Northwest Territories Canada
Canadian carrier strategies and the 1995 open skies agreement
Kaduck, Raymon J., Kaduck (Raymon J.), Canada; The Conference Proceedings of the 1997 Air Transport Research Group (ATRG) of the WCTR Society; Oct. 1997; Volume 1, No. 1; 19p; In English; See also 19990021379; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A02, Microfiche

The Canada-US "Open Skies" negotiation took place during a brief period which spanned the fall of 1994 and early 1995. It was conducted through personal representatives and later in the formal bargaining sessions. After nearly 30 years of acrimonious exchanges between the two governments, the 1995 agreement was concluded with surprisingly little difficulty, and has ushered in a new era in transborder air transport. This paper focuses on Canadian carrier strategy before and after the agreement.
Derived from text
Air Transportation; Canada; Airline Operations; Civil Aviation; Agreements

19990021388 California Univ., Berkeley, CA USA
Modeling intercontinental demand: an integration of demand analysis and trade theory
Gillen, David, California Univ., USA; Harris, Richard, Simon Fraser Univ., Canada; Oum, Tae, British Columbia Univ., Canada; The Conference Proceedings of the 1997 Air Transport Research Group (ATRG) of the WCTR Society; Oct. 1997; Volume 1, No. 1; 23p; In English; See also 19990021379; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A02, Microfiche

This presentation reports on the efforts to model intercontinental demand, i.e., the gains and losses of the international airline industry which resulted from policy changes aimed at liberalization of the regulation of the airline industry. The specific countries airlines which were studied were Japan, Korea, Canada, and the USA. The specific categories of the Airline business included in the model were: (1) Market Access, (2) Designation, (3) Capacity and frequency controls, (4) Tariffs. Projections of possible cost savings are included. This document is in Viewgraph format.
Author
Airline Operations; Civil Aviation; Cost Reduction; Economic Analysis

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

19990019756 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Interferometric GPS/Micro-Mechanical Gyro Attitude Determination System: A Study Into the Integration Issues
Giustino, Antonio; Oct. 14, 1998; 126p; In English
Report No.(s): AD-A356190; AFIT-98-090; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The near future will see a proliferation of small low cost communication and science satellites with modest (0.1-0.5 deg) pointing requirements which will use attitude determination Systems (ADS's) of low power, weight, size, and cost. This project proposes to synthesize two in-house navigation systems as an alternative for the traditional LEO/MEO spacecraft ADS suite. This system consists of the Draper Micro-Mechanical (MM) gyroscopes aided by an interferometric GPS (IGPS) receiver. The two systems are integrated in a highly-coupled design through an extended Kalman filter (EKF).
DTIC
Satellite Attitude Control; Communication Satellites; Global Positioning System; Interferometry; Navigation; Gyroscopes

19990021246 Federal Aviation Administration, Technical Center, Atlantic City, NJ USA
Use of Leica Differential Global Positioning System (DGPS) as an Aircraft Precision Tracker
Stevens, Anthony J.; Apr. 1998; 16p; In English
Report No.(s): AD-A358177; DOT/FAA/CT-TN98/8; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Leica (formerly Magnavox) Differential Global Positioning System (DGPS) is a two-receiver GPS system which permits the collection of highly accurate positions of Federal Aviation Administration (FAA) aircraft. While the William J. Hughes Technical Center has excellent aircraft tracking assets at its Atlantic City International Airport (ACY) location, obtaining tracking services at other locations has proven costly and problematic. This report details the results of flight testing performed at the William J. Hughes Technical Center to demonstrate that the Leica DGPS provides a flexible and reasonably accurate replacement for other forms of aircraft tracking. Aircraft equipped with the Leica DPGS system flew a series of approaches to ACY and data collected

from the Leica DGPS system was compared to a highly accurate GTE Precision Automated Tracking System (PATS) Laser Tracker. The Leica DPGS system was found accurate to better than 13 feet.
DTIC
Global Positioning System; Tracking (Position); Aircraft Detection; Automatic Control

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19990019708 **University of South Florida, Dept. of Civil and Environmental Engineering, Tampa, FL USA**
Update of the Starship Fuselage Finite Element Model Using Modal Data
Hassiotis, Sophia, University of South Florida, USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 67; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

An accurate analytical model of the Beechcraft Starship fuselage is needed to design the acoustic response in the main cabin of the aircraft. The initial dynamic response produced by a finite element model did not agree with measured data. This is due to the complexity of the aircraft. In this project, numerous parameters were identified and updated to achieve agreement between the analytical and measured response. The Starship is a new 10-passenger aircraft with a unique all-composite construction. The composite consists of a honeycomb which is sandwiched on either side by four graphite epoxy plies. Aluminum stiffeners, reinforcements placed on the floor and around windows, and an unknown distribution of the mass added to the overall complexity of the structure. An initial MSC/NASTRAN finite element model produced errors in the natural frequencies in excess of 40% of those measured in laboratory tests. In addition, the weight of the aircraft given by the model was 449 lbs less than measured. First, the model was updated to correct the amount and distribution of mass. Examination of core samples indicated that two additional composite plies needed to be included in the main cabin area. IN addition, weight was added to compensate for paint, rivets, epoxy, and concentrated masses. Finally, the thickness of each ply was increased to account for numerical error in measurement. The updates added the necessary weight. Parameters which defined the structural stiffness were modified to produce better agreement between model and measured frequencies. Namely, the elastic constants he composite were changed to more accurately reflect the values found in the literature. The mass and stiffness updates produced a model which predicted the natural frequencies measured in the laboratory.
Author
Graphite-Epoxy Composites; Honeycomb Structures; Passenger Aircraft; Mathematical Models; Finite Element Method; Elastic Properties; Epoxy Resins; Dynamic Response

19990019857 **NASA Langley Research Center, Hampton, VA USA**
Engineering Overview of a Multidisciplinary HSCT Design Framework Using Medium-Fidelity Analysis Codes
Weston, R. P., NASA Langley Research Center, USA; Green, L. L., NASA Langley Research Center, USA; Salas, A. O., NASA Langley Research Center, USA; Samareh, J. A., NASA Langley Research Center, USA; Townsend, J. C., NASA Langley Research Center, USA; Walsh, J. L., NASA Langley Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 133-134; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

An objective of the HPCC Program at NASA Langley has been to promote the use of advanced computing techniques to more rapidly solve the problem of multidisciplinary optimization of a supersonic transport configuration. As a result, a software system has been designed and is being implemented to integrate a set of existing discipline analysis codes, some of them CPU-intensive, into a distributed computational framework for the design of a High Speed Civil Transport (HSCT) configuration. The proposed paper will describe the engineering aspects of integrating these analysis codes and additional interface codes into an automated design system. The objective of the design problem is to optimize the aircraft weight for given mission conditions, range, and payload requirements, subject to aerodynamic, structural, and performance constraints. The design variables include both thicknesses of structural elements and geometric parameters that define the external aircraft shape. An optimization model has been adopted that uses the multidisciplinary analysis results and the derivatives of the solution with respect to the design variables to formulate a linearized model that provides input to the CONMIN optimization code, which outputs new values for the design variables. The analysis process begins by deriving the updated geometries and grids from the baseline geometries and grids using the new values for the design variables. This free-form deformation approach provides internal FEM (finite element method) grids that are consistent with aerodynamic surface grids. The next step involves using the derived FEM and section properties in a

weights process to calculate detailed weights and the center of gravity location for specified flight conditions. The weights process computes the as-built weight, weight distribution, and weight sensitivities for given aircraft configurations at various mass cases. Currently, two mass cases are considered: cruise and gross take-off weight (GTOW). Weights information is obtained from correlations of data from three sources: 1) as-built initial structural and non-structural weights from an existing database, 2) theoretical FEM structural weights and sensitivities from Genesis, and 3) empirical as-built weight increments, non-structural weights, and weight sensitivities from FLOPS. For the aeroelastic analysis, a variable-fidelity aerodynamic analysis has been adopted. This approach uses infrequent CPU-intensive non-linear CFD to calculate a non-linear correction relative to a linear aero calculation for the same aerodynamic surface at an angle of attack that results in the same configuration lift. For efficiency, this nonlinear correction is applied after each subsequent linear aero solution during the iterations between the aerodynamic and structural analyses. Convergence is achieved when the vehicle shape being used for the aerodynamic calculations is consistent with the structural deformations caused by the aerodynamic loads. to make the structural analyses more efficient, a linearized structural deformation model has been adopted, in which a single stiffness matrix can be used to solve for the deformations under all the load conditions. Using the converged aerodynamic loads, a final set of structural analyses are performed to determine the stress distributions and the buckling conditions for constraint calculation. Performance constraints are obtained by running FLOPS using drag polars that are computed using results from non-linear corrections to the linear aero code plus several codes to provide drag increments due to skin friction, wave drag, and other miscellaneous drag contributions. The status of the integration effort will be presented in the proposed paper, and results will be provided that illustrate the degree of accuracy in the linearizations that have been employed.
Author
Aircraft Design; Multidisciplinary Design Optimization; Design Analysis; Iterative Solution; Applications Programs (Computers); Software Engineering; Finite Element Method

19990019864 **Computer Sciences Corp., Hampton, VA USA**
An Object Oriented Framework for HSCT Design
Sistla, Raj, Computer Sciences Corp., USA; Dovi, Augustine R., Computer Sciences Corp., USA; Su, Philip, Computer Sciences Corp., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 171-176; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Aircraft design is inherently iterative in nature and multidisciplinary in composition. The process is complicated by the fact that the focus and approach of each discipline can be quite distinct, and multiple invocations of the discipline programs are required to arrive at a feasible design. The usual result is a design procedure that is largely inflexible and computationally taxing. An earlier effort within the Framework for Interdisciplinary Design and Optimization (FIDO) project used Parallel Virtual Machine (PVM) to handle communications between discipline codes executing in a "host/slave" mode. This framework was sensitive to the host operating system and changing the analytical connectivity or switching discipline codes required major programming intervention. The goal of the current framework is to provide a prooramming environment for automating the distribution of a complex computing task over a networked, heterogeneous system of computers. These computers may include: engineering workstations, vector supercomputers, and parallel-processing computers. They work on their individual parts of the design, in parallel whenever possible, and have access to centralized data. Each computational task is assigned to the most appropriate computer type. The present framework provides a means for automating the overall design process. It provides communication and control between components, which include the diverse discipline computations in a design problem and the system services facilitating the design.
Derived from text
Multidisciplinary Design Optimization; Aircraft Design; Computer Techniques; Programming Environments; Object-Oriented Programming; Computer Networks; Design Analysis

19990021055 **Isothermal Community Coll., Spindale, NC USA**
Harnessing the Brute: The Development of Propulsion Controlled Aircraft at NASA Dryden
Tucker, Tom, Isothermal Community Coll., USA; Oct. 1998; 3p; In English; See also 19990021025; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

PCA, Performance Control Aircraft, is a backup flight control system for use when an airplane has lost all its hydraulics and normal flight controls. PCA is an autopilot system which modulates the thrust of the engines to provide lateral and longitudinal direction and enables the pilots to land the airplane. NASA Dryden has developed this technology in flight, ground simulator, and analytic studies which started as early as 1989. NASA Dryden has combined efforts with NASA Ames, McDonnell Aerospace St. Louis, Douglass Aircraft Long Beach, Honeywell, Pratt & Whitney, the US Air Force, and the US Navy to develop PCA to the point where it is feasible to bring a commercial airliner not just to a survivable crash landing but to a normal landing. The purpose of my project was to develop a history of an invention which evolved by group problem-solving. My focus was not on validations arrived at -- these are already documented in technical reports -- but on the inventive process. I have previously pub-

lished work about individual inventors and their processes, one of these studies concerning Philo Farnsworth's Image Dissector, the crucial invention for all-electronic television. The Image Dissector history concerns the classic lone inventor scenario. But PCA is the history of often reconfigured teams developing an invention in our modern environment governed by complex commercial and regulatory units, a story of, as one engineer put it, "how you push a good idea through the system."
Author
Automatic Pilots; Electronic Equipment; Flight Control; Flight Simulators

19990021620 **Boeing Commercial Airplane Co., Labs. and Techuology Standards, Seattle, WA USA**
Jet Transport Structures Performance Monitoring
Goranson, Ulf, Boeing Commercial Airplane Co., USA; National Educators' Workshop: Update 1997. Standard Experiments in Engineering Materials, Science, and Technology; November 1998, pp. 1-38; In English; See also 19990021619; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Structural safety is an evolutionary accomplishment, and attention to design features is key to its achievement. Acquisition and review of service data and other firsthand information from customer airlines is necessary to promote safe and economic operation of the worldwide Boeing fleet. Technology standards are used to ensure analysis commonality across different models, and operational loading spectra variations are monitored through sampling with digital flight data recorders, as well as traditional speed/acceleration/altitude (V-G-H) recordings. Structural performance validation of new aircraft includes full-scale static and fatigue testing. Similar tests and teardowns are conducted on older airframes retired from service, to gain better understanding of corrosion and/or accidental damage, as well as structural repairs and service-caused defects. Boeing has, in addition, conducted fleet surveys over the last 10 years to get firsthand knowledge of structural performance of aging jet transport systems and structures. This paper describes these structural health monitoring approaches.
Author
Transport Aircraft; Systems Health Monitoring; Aircraft Construction Materials; Life (Durability); Structural Reliability; Aircraft Structures

19990021660 **Boeing Co., High Speed Civil Transport Aero Dynamics, Seattle, WA USA**
High Speed Civil Transport: Design Challenges
Lund, David W., Boeing Co., USA; National Educators' Workshop: Update 1997. Standard Experiments in Engineering Materials, Science, and Technology; November 1998, pp. 459-490; In English; See also 19990021619; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper summarizes the advantages of building a High Speed Civil Transport(HSCT). Several of the points discussed include: 1) an adequate future market; 2) economic viability; 3) good potential for environmental compliance with technology development; 4) development of key technologies vital for program go-ahead; and 5) manufacturing and design technologies must meet economic goals.
Derived from text
Supersonic Transports; Civil Aviation; Passenger Aircraft; Economic Factors

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

19990019847 **NASA Lewis Research Center, Cleveland, OH USA**
3D Multistage Simulation of Each Component of the GE90 Turbofan Engine
Turner, Mark, General Electric Co., USA; Topp, Dave, General Electric Co., USA; Veres, Joe, NASA Lewis Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 87; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

A 3D multistage simulation of each component of the GE90 Turbofan engine has been made. This includes 49 blade rows. A coupled simulation of all blade rows will be made very soon. The simulation is running using two levels of parallelism. The first level is on a blade row basis with information shared using files. The second level is using a grid domain decomposition with information shared using MPI. Timings will be shown for running on the SP2, an SGI Origin and a distributed system of HP workstations. On the HP workstations, the CHIMP version of MPI is used, with queuing supplied by LSF (Load Sharing Facility). A script-based control system is used to ensure reliability. An MPEG movie illustrating the flow simulation of the engine has been

created using PV3, a parallel visualization library created by Bob Haimes of MIT. PVM is used to create a virtual machine from 10 HP workstations and display on an SGI workstation. A representative component simulation will be compared to rig data to demonstrate its usefulness in turbomachinery design and analysis.
Author
Turbofan Engines; Engine Design; Engine Parts; Computerized Simulation; Parallel Processing (Computers); Distributed Processing

19990019848 ASE Technologies, Inc., Cincinnati, OH USA
Application of Multi-Stage Viscous Flow CFD Methods for Advanced Gas Turbine Engine Design and Development
Subramanian, S., ASE Technologies, Inc., USA; Vitt, Paul, ASE Technologies, Inc., USA; Cherry, David, General Electric Co., USA; Turner, Mark, General Electric Co., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 89-90; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

The primary objective of the research is to develop, apply and demonstrate the capability and accuracy of 3-D multi-stage CFD methods as efficient design tools on high-performance computer platforms, for the development of advanced gas turbine engines. Propulsion systems that are planned and that are currently in development for next generation civilian and military aircraft applications under NASA's Advanced Subsonic Technology (AST), DoD's Integrated High Performance Turbine Engine Technology (IHPTET) programs will be required to operate under complex flow conditions, imposed by strict performance expectations and goals. Some of the expectations and goals include higher thrust, lower emission levels, higher pressure ratios, smaller size, lower weight, fewer stages, lower fuel consumption and higher efficiency. These goals necessitate blades with high turning angles, stages with small axial gaps between blade rows, and non-axisymmetric flowpath. It becomes important to use design methods that treat the stator and rotor airfoils as a complete system for providing information regarding the influence of one blade row on the other for overall engine performance. The particular aspect of this very complex problem that is presently of interest to NASA and to US Aircraft Engine companies, and the focal point of this research is the prediction and understanding of the 3-D multi-stage interaction effects in advanced gas turbine engines. More importantly, to use the information for design optimization and performance improvements in next generation engines to power US commercial and military aircraft. Using the HPCCP computational resources, several 3-D multi-stage aerodynamic analyses were performed for high pressure and low pressure turbine designs under flight and rig conditions. Results are presented here for a Boeing 777 class, high and low pressure turbine engine stage configuration at take-off conditions. The analysis included cooling flow addition details and effects of seal leaks through both turbine stages to realistically represent the actual engine operation. The turbine geometry consisted of 18 blade rows, that were solved simultaneously due to fully subsonic flow conditions. Using the parallel version of the average passage code and with a total of 9.4 million grid points, results were obtained using typically 16 to 60 processors. Load balancing the processors between blade rows provided good parallel efficiency. The overall agreement of the rig analysis with experimental data was very good, providing confidence in the average passage solution approach. The HPCCP computational resource was an excellent testbed for these real world simulations, and very good parallel performance efficiencies were achieved for these complex flow analyses.
Author
Computational Fluid Dynamics; Gas Turbine Engines; Engine Design; Propulsion System Configurations; Propulsion System Performance; Optimization; Viscous Flow; Parallel Processing (Computers)

19990019858 Allison Engine Co., Indianapolis, IN USA
Turbine Engine HP/LP Spool Analysis
Hall, Edward J., Allison Engine Co., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 137-142; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The primary objective of this task is to develop and demonstrate the capability to analyze the aerodynamics in the complete high pressure (HP) and low pressure (LP) subsystems of both the NASA/General Electric (GE) Energy Efficient Engine (EEE) and the Allison AE3007 engine using three-dimensional Navier-Stokes numerical models. The analysis will evaluate the impact of steady aerodynamic interaction effects between the components of the HP and LP subsystems. The computational models shall be developed from the geometric components contained in the HP and LP subsystems including: engine nacelle, inlet, fan blades, bifurcated bypass and core inlet, bypass vanes, core inlet guide vanes, booster stage, core compressor blades, high pressure turbine blades, low pressure turbine blades, mixer, and exhaust nozzle. Predictions will be obtained using the ADPAC aerodynamic analysis code. The analysis shall be performed and optimized for workstation cluster computing platforms using parallel processing techniques. The concept of "zooming" in the analysis shall be demonstrated by substituting a lower order cycle model of the HP

or LP subsystems using results from the National Cycle Program (NCP). Ultimately, the analysis will include the effects of operation at angle of attack by modeling a complete rotation of the fan wheel.
Author
Gas Turbine Engines; Three Dimensional Models; Parallel Processing (Computers); Navier-Stokes Equation; Mathematical Models; Engine Design; Aerodynamic Characteristics; Computerized Simulation

19990019865 NASA Lewis Research Center, Cleveland, OH USA
National Cycle Program (NCP) Common Analysis Tool for Aeropropulsion
Follen, G., NASA Lewis Research Center, USA; Naiman, C., NASA Lewis Research Center, USA; Evans, A., NASA Lewis Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 177-181; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Through the NASA/Industry Cooperative Effort (NICE) agreement, NASA Lewis and industry partners are developing a new engine simulation, called the National Cycle Program (NCP), which is the initial framework of NPSS. NCP is the first phase toward achieving the goal of NPSS. This new software supports the aerothermodynamic system simulation process for the full life cycle of an engine. The National Cycle Program (NCP) was written following the Object Oriented Paradigm (C++, CORBA). The software development process used was also based on the Object Oriented paradigm. Software reviews, configuration management, test plans, requirements, design were all apart of the process used in developing NCP. Due to the many contributors to NCP, the stated software process was mandatory for building a common tool intended for use by so many organizations. The U.S. aircraft and airframe companies recognize NCP as the future industry standard for propulsion system modeling.
Derived from text
Computerized Simulation; Engine Design; Programming Environments; Applications Programs (Computers); Computer Techniques

19990021018 Syracuse Univ., Dept. of Mechanical, Aerospace, and Manufacturing Engineering, NY USA
A Computer Investigation of a Lobed-Mixer Fuel-Injection Strut in a Scramjet Engine Model *Final Report, Jun. 1994 - Jun. 1997*
Campuzano, Mario Felipe, Syracuse Univ., USA; Dang, Thong Q., Syracuse Univ., USA; May 1997; 98p; In English; Original contains color illustrations
Contract(s)/Grant(s): NGT-70380; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

A method of enhancing fuel/air mixing using streamwise vorticity for scramjet applications is presented. The generation of large-scale streamwise vortices is achieved by the incorporation of a lobed-mixer device into the fuel-injection struts of a proposed NASA scramjet engine. Conceptually, the lobed-mixer strut design is a three-dimensional lifting surface with a sinusoidal spanwise lift distribution. In the flow passage between the strut leading- and trailing-edges, the presence of a spanwise pressure gradient generates secondary flows. In the region behind the strut, which is a lifting surface, the shed vorticity system consists of periodic large-scale counter-rotating streamwise vortices. to evaluate this hypermixer concept, CFD calculations were carried out at supersonic combustor inlet Mach numbers ranging from 2 to 3 for cold flows. This concept is first analyzed for a 3D cascade of struts in inviscid flows. Results from this preliminary work reveal that significant secondary flows are generated in and behind the strut regions, while the additional shock losses associated with the lobed strut is small. Results confirm that the mechanism of generating streamwise vorticity is an inviscid phenomenon; the shed vorticity (i.e. streamwise vorticity) behind the strut is proportional to the pressure loading along the strut (Kutta-Joukowsky theorem). The next stage of this investigation considers the effects of viscosity on the generation of streamwise vorticity (or secondary flow). The geometry considered is a single lobed strut with "slip" side walls. Here, the NASA Reynolds-Averaged Navier-Stokes LARCK code (Langley Algorithm for Research in Chemical Kinetics) was used. Relative to the inviscid-flow results, in the absence of flow separation, viscous effects introduce blockage into the flow passage, causing a small reduction in pressure loading and hence a slight reduction in secondary flow. In the presence of flow separation, the strut pressure loading can be significantly reduced, resulting in a large reduction in secondary flow. Next, the effect of Mach number on the strength of the streamwise vorticity is investigated. For the configuration studied, the pressure loading along the strut (hence the magnitude of secondary flow) was found to be a strong function of the strength and angle of the leading-edge shocks, which depends on the inflow Mach number. Finally, preliminary experimental verification of this hypermixer concept was carried out. Flow visualizations confirm the presence of strong large-scale streamwise vortices downstream of the strut.
Author
Supersonic Combustion Ramjet Engines; Fuel Injection; Flow Visualization; Secondary Flow; Supersonic Inlets; Trailing Edges; Vorticity; Reynolds Averaging; Pressure Gradients; Leading Edges

19990021241 NASA Lewis Research Center, Cleveland, OH USA

Noise Certification Predictions for FJX-2-Powered Aircraft Using Analytic Methods

Berton, Jeffrey J., NASA Lewis Research Center, USA; February 1999; 23p; In English

Contract(s)/Grant(s): RTOP 523-12-13

Report No.(s): NASA/TM-1999-208908; NAS 1.15:208908; E-11522; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Williams International Co. is currently developing the 700-pound thrust class FJX-2 turbofan engine for the general Aviation Propulsion Program's Turbine Engine Element. As part of the 1996 NASA-Williams cooperative working agreement, NASA agreed to analytically calculate the noise certification levels of the FJX-2-powered V-Jet II test bed aircraft. Although the V-Jet II is a demonstration aircraft that is unlikely to be produced and certified, the noise results presented here may be considered to be representative of the noise levels of small, general aviation jet aircraft that the FJX-2 would power. A single engine variant of the V-Jet II, the V-Jet I concept airplane, is also considered. Reported in this paper are the analytically predicted FJX-2/V-Jet noise levels appropriate for Federal Aviation Regulation certification. Also reported are FJX-2/V-Jet noise levels using noise metrics appropriate for the propeller-driven aircraft that will be its major market competition, as well as a sensitivity analysis of the certification noise levels to major system uncertainties.

Author

Jet Aircraft Noise; Turbofan Engines; General Aviation Aircraft; Engine Noise; Noise Prediction (Aircraft); Certification

19990021365 NASA Lewis Research Center, Cleveland, OH USA

Comparison of Techniques for Non-Intrusive Fuel Drop Size Measurements in a Subscale Gas Turbine Combustor

Zaller, Michelle, NASA Lewis Research Center, USA; Anderson, Robert C., NASA Lewis Research Center, USA; Hicks, Yolanda R., NASA Lewis Research Center, USA; Locke, Randy J., DYNACS Engineering Co., Inc., USA; February 1999; 13p; In English; Optical Technology and Image Processing in Fluid, Thermal, and Combustion Flow, 6-10 Dec. 1998, Yokohama, Japan; Sponsored by Visualization Society of Japan, Japan

Contract(s)/Grant(s): RTOP 537-05-20

Report No.(s): NASA/TM-1999-208909; NAS 1.15:208909; E-11523; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In aviation gas turbine combustors, many factors, such as the degree and extent of fuel/air mixing and fuel vaporization achieved prior to combustion, influence the formation of undesirable pollutants. to assist in analyzing the extent of fuel/air mixing, flow visualization techniques have been used to interrogate the fuel distributions during subcomponent tests of lean-burning fuel injectors. Discrimination between liquid and vapor phases of the fuel was determined by comparing planar laser-induced fluorescence (PLIF) images, elastically-scattered light images, and phase/Doppler interferometer measurements. Estimates of Sauter mean diameters are made by ratioing PLIF and Mie scattered intensities for various sprays, and factors affecting the accuracy of these estimates are discussed. Mie calculations of absorption coefficients indicate that the fluorescence intensities of individual droplets are proportional to their surface areas, instead of their volumes, due to the high absorbance of the liquid fuel for the selected excitation wavelengths.

Author

Flow Visualization; Nonintrusive Measurement; Drop Size; Size Determination; Fuel Sprays; Combustion; Liquid Fuels; Gas Turbines; Fuel Injection; Fuel-Air Ratio

19990021560 Allison Engine Co., Indianapolis, IN USA

Design of a Low Speed Fan Stage for Noise Suppression *Final Report*

Dalton, W. N., Allison Engine Co., USA; Elliot, D. B., Allison Engine Co., USA; Nickols, K. L., Allison Engine Co., USA; Feb. 1999; 560p; In English

Contract(s)/Grant(s): NAS3-25950; RTOP 538-03-11

Report No.(s): NASA/CR-1999-208682; Allison-EDR-17923; E-11423; NAS 1.26:208682; No Copyright; Avail: CASI; A24, Hardcopy; A04, Microfiche

This report describes the design of a low tip speed, moderate pressure rise fan stage for demonstration of noise reduction concepts. The fan rotor is a fixed-pitch configuration delivering a design pressure ratio of 1.378 at a specific flow of 43.1 lbm/sec/sq ft. Four exit stator configurations were provided to demonstrate the effectiveness of circumferential and axial sweep in reducing rotor-stator interaction tone noise. The fan stage design was combined with an axisymmetric inlet, conical convergent nozzle, and nacelle to form a powered fan-nacelle subscale model. This model has a 22-inch cylindrical flow path and employs a rotor with a 0.30 hub-to-tip radius ratio. The design is fully compatible with an existing NASA force balance and rig drive system. The stage aerodynamic and structural design is described in detail. Three-dimensional (3-D) computational fluid dynamics (CFD) tools

were used to define optimum airfoil sections for both the rotor and stators. A fan noise predictive system developed by Pratt & Whitney under contract to NASA was used to determine the acoustic characteristics of the various stator configurations. Parameters varied included rotor-to-stator spacing and vane leading edge sweep. The structural analysis of the rotor and stator are described herein. An integral blade and disk configuration was selected for the rotor. Analysis confirmed adequate low cycle fatigue life, vibratory endurance strength, and aeroelastic suitability. A unique load carrying stator arrangement was selected to minimize generation of tonal noise due to sources other than rotor-stator interaction. Analysis of all static structural components demonstrated adequate strength, fatigue life, and vibratory characteristics.
Author
Turbofans; Fan Blades; Engine Design; Noise Reduction; Rotors; Stators; Sweep Effect

19990024925 United Technologies Corp., East Hartford, CT USA
Advanced Low Emissions Subsonic Combustor Study *Final Report*
Smith, Reid, United Technologies Corp., USA; December 1998; 82p; In English
Contract(s)/Grant(s): NAS3-26618; RTOP 538-17-10
Report No.(s): NASA/CR-1998-207931; E-11199; NAS 1.26:207931; PWA-6420-28; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Recent advances in commercial and military aircraft gas turbines have yielded significant improvements in fuel efficiency and thrust-to-weight ratio, due in large part to increased combustor operating pressures and temperatures. However, the higher operating conditions have increased the emission of oxides of nitrogen (NOx), which is a pollutant with adverse impact on the atmosphere and environment. Since commercial and military aircraft are the only important direct source of NOx emissions at high altitudes, there is a growing consensus that considerably more stringent limits on NOx emissions will be required in the future for all aircraft. In fact, the regulatory communities have recently agreed to reduce NOx limits by 20 percent from current requirements effective in 1996. Further reductions at low altitude, together with introduction of limits on NOx at altitude, are virtual certainties. In addition, the U.S. Government recently conducted hearings on the introduction of federal fees on the local emission of pollutants from all sources, including aircraft. While no action was taken regarding aircraft in this instance, the threat of future action clearly remains. In these times of intense and growing international competition, the U.S. le-ad in aerospace can only be maintained through a clear technological dominance that leads to a product line of maximum value to the global airline customer. Development of a very low NOx combustor will be essential to meet the future needs of both the commercial and military transport markets, if additional economic burdens and/or operational restrictions are to be avoided. In this report, Pratt & Whitney (P&W) presents the study results with the following specific objectives: Development of low-emissions combustor technologies for advances engines that will enter into service circa 2005, while producing a goal of 70 percent lower NOx emissions, compared to 1996 regulatory levels. Identification of solution approaches to barriers to the productization and economic viability of the low-emissions technologies. Preparation of these technologies to facilitate an annular rig high-pressure demonstration.
Author
Combustion Chambers; Aircraft Engines; Commercial Aircraft; Gas Turbine Engines; Nitrogen Oxides; Operating Temperature; Thrust-Weight Ratio

19990024943 NASA Dryden Flight Research Center, Edwards, CA USA
Factors Affecting Inlet-Engine Compatibility During Aircraft Departures at High Angle of Attack for an F/A-18A Aircraft
Steenken, W. G., General Electric Co., USA; Williams, J. G., General Electric Co., USA; Yuhas, A. J., Analytical Services and Materials, Inc., USA; Walsh, K. R., NASA Dryden Flight Research Center, USA; February 1999; 200p; In English
Contract(s)/Grant(s): NAS3-26617; RTOP 529-31-04-00-37
Report No.(s): NASA/TM-1999-206572; H-2327; NAS 1.15:206572; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The F404-GE-400 engine powered F/A-18A High Alpha Research Vehicle (HARV) was used to examine the quality of inlet airflow during departed flight maneuvers, that is, during flight outside the normal maneuvering envelope where control surfaces have little or no effectiveness. A series of six nose-left and six nose-right departures were initiated at Mach numbers between 0.3 and 0.4 at an altitude of 35 kft. The yaw rates at departure recovery were in the range of 40 to 90 degrees per second. Engine surges were encountered during three of the nose-left and one of the nose-right departures. Time-variant inlet-total-pressure distortion levels at the engine face were determined to not significantly exceed those measured at maximum angle-of-attack and -sideslip maneuvers during controlled flight. Surges as a result of inlet distortion levels were anticipated to initiate in the fan. Analysis revealed that the surges initiated in the compressor and were the result of a combination of high levels of inlet distortion and rapid changes in aircraft motion. These rapid changes in aircraft motion are indicative

of a combination of engine mount and gyroscopic loads being applied to the engine structure that impact the aerodynamic stability of the compressor through changes in the rotor-to-case clearances.
Author
F-18 Aircraft; Aerodynamic Stability; Angle of Attack; Compressors; Control Surfaces; Flight Control; Research Vehicles; Rotors; Subsonic Speed

19990025121 Virginia Polytechnic Inst. and State Univ., Dept. of Mechanical Engineering, Blacksburg, VA USA
A High Speed Motion Analyzer for Research on the Effects of Shock on the Aerodynamic Forcing of Transonic Turbine Blades *Final Report, 1 Mar. 1997 - 28 Feb. 1998*
Ng, Wing; Sep. 1998; 5p; In English
Contract(s)/Grant(s): F49620-97-1-0113
Report No.(s): AD-A358418; AFRL-SR-BL-TR-98-0853; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

A research program was conducted to study the effects of steady and unsteady shock impingement on the film-cooling heat transfer turbine blades. The objective of the program is to improve the fundamental physical understanding of how these unsteady phenomena affect the film-cooling heat transfer under simulated thermal and flow conditions typical of real turbine engines. The experimental program is being conducted in the Virginia Tech heated, transonic turbine cascade tunnel. Both steady and unsteady shocks were investigated: the steady shock originates from the trailing edge of the blade and impinges on the suction surface of the adjacent blade; whereas the unsteady shock(s) are generated from a shock tube and pass into the cascade upstream of the blades to simulate the interaction of a moving shock from the upstream stationary nozzle guide vane on the downstream rotating blade row. The blade geometry and film-cooling hole pattern were designed by GE Aircraft Engines.
DTIC
Aircraft Engines; Cascade Flow; Film Cooling; Guide Vanes; Heat Transfer; High Speed; Impingement; Rotation

08
AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

19990019716 Old Dominion Univ., Dept. of Aerospace Engineering, Norfolk, VA USA
Autoparametric Control of Helicopter Ground Resonance
Kunz, Donald L., Old Dominion Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 76; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

This research focused on using autoparametric absorbers and saturation control to suppress helicopter ground resonance. In virtually every helicopter, ground resonance instabilities are eliminated by incorporating lag dampers in the rotor design to dissipate the energy transferred to the lag motion of the blades when the regressing cyclic lag and rigid-body fuselage modes coalesce. In addition to the blade dampers, it is frequently necessary to incorporate dampers in the landing gear of the aircraft, in order to obtain sufficient energy dissipation. The benefit of replacing the blade-mounted lag dampers with autoparametric absorbers would be to significantly reduce the weight and drag penalty associated with the dampers. In this investigation, the equations of motion used to model ground resonance were based on the classical equations derived by Coleman and Feingold. Only the minimum number of degrees of freedom were retained, including fuselage longitudinal translation, rotor cosine cyclic lag and rotor sine cyclic lag motions. Three absorber equations were then appended to the ground resonance equations, one for each degree of freedom; and they were coupled to the fuselage equation with quadratic nonlinear terms. The design of the absorbers required an analytical solution of these six, simultaneous, nonlinear, ordinary differential equations. The method of multiple scales was used to obtain the solution. Obtaining a solution for the equations, and therefore a design for the absorbers, presented difficulties not previously encountered in applications of this type of absorber. First, because of the Coriolis coupling between the rotor lag degrees of freedom, there is no set of principal coordinates that will result in a set of uncoupled natural modes for the system. Second, because of the comparatively large number of equations needed to model ground resonance and the absorbers, the solutions of the equations became very complex and cumbersome. The solutions of the first-order equations were obtained quite easily, since the rotor equations were not coupled to the three, independent absorber equations. However, the analytical solutions to the rotor/fuselage equations were extremely complex. The solution of the second-order equations presented some difficulties that have yet to be resolved. The fundamental question is how to represent the natural rotor/fuselage modes in the absorber equations. It would be easier to make the coupling implicit by introducing three modal variables, but this approach might not lead to an adequate consider-

ation of the coupling in the second-order solution. The alternative leads to a very complex set of equations. In short, additional work will be required before an adequate design for the absorbers can be obtained.
Author
Helicopters; Uncoupled Modes; Nonlinear Equations; Landing Gear; Ground Resonance; Fuselages; Energy Dissipation; Degrees of Freedom

19990019832 Rensselaer Polytechnic Inst., Troy, NY USA
Adaptive Computation of Rotor-Blades in Hover
Dindar, Mustafa, Rensselaer Polytechnic Inst., USA; Kenwright, David, MRJ Technology Solutions, USA; Jansen, Ken, Rensselaer Polytechnic Inst., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 3-8; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

An adaptive refinement procedure is developed for computing vortical flows encountered in rotor aerodynamics. For this purpose, an error indicator based on interpolation error estimate is formulated and coded into an adaptive finite element framework. It is shown that the error indicator based on interpolation error estimate is effective in resolving the global features of the flow-field. Furthermore, for efficiency and problem size considerations, once the interpolation errors are reduced to acceptable levels, the adaptive refinement is done only in regions affected by the vortical flows. to do this a novel vortex core detection technique is used to capture vortex tubes. The combination of interpolation error estimate and vortex core detection technique proved to be very effective in computing vortical flow-field of rotor blades. Using this two-level adaptive refinement procedure the UH-60A BlackHawk rotor is analyzed in hover flow conditions.
Author
Error Detection Codes; Rotor Aerodynamics; Iterative Solution; Vortices; Systematic Errors; Interpolation; Finite Element Method; Computational Grids; Flow Distribution

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

19990019705 Rochester Inst. of Tech., Dept. of Mechanical Engineering, NY USA
Implementation of TWNTN4A at the 0.3 Meter Transonic Cryogenic Tunnel
Ghosh, Amitabha, Rochester Inst. of Tech., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 63; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

TWNTN4A is a nonlinear, transonic, small disturbance code for correcting wall interference effects in 2-D wind tunnels. Incorporated into this potential flow solver is the capability to account for the important effects of the boundary layer growths on the wind tunnel sidewalls. The original TWINTAN code was developed about 20 years ago for post-test use; however, improved computer technology now allows on-line implementation. The object of this research is to implement the code in the test cycle and enhance capabilities of the 0.3 m. Transonic Cryogenic Tunnel (TCT) at NASA-Langley. TWNTN4A has three calculation cycles - tunnel calculations, free-air calculations and perturbation flow calculations. The tunnel calculations are an inverse design procedure to generate an effective inviscid body using the tunnel wall pressure measurements as boundary conditions with the free stream velocity and Mach number the same as the experimental test case. The effective inviscid body shape which produces the same blockage effect (drag coefficients) then undergoes the second cycle of calculation. In this cycle the flow of free-air is calculated around the equivalent shape while the angle of attack is corrected to satisfy the Kutta condition for lift corresponding to the tunnel flow. During the convergence process, the far field velocity and Mach number are upgraded using an optimization algorithm which tries to match the free-airflow pressure distribution around the airfoil. When the second cycle is complete the correction quantities for angle of attack and Mach number are available. However to determine further the effect of the model and wall effects, a third cycle is run which solves the free- air flow with the singularity distribution obtained in the first cycle and the corrected free- stream conditions obtained from the second. Wall effects are the difference between the total perturbation from the first cycle and model perturbations from the second. The focus of this work was to convert a research code into a production code, streamline the process where possible, prepare on-line documentation, upgrade input and output capabilities and deliver a single code for different operating systems. The program which used to take several hours for convergence in the old system now runs under 10 seconds in the DEC Alpha system available at TCT. Thus, TWNTN4A will be available for real-time data correction for future tests. Additionally, new TECPLOT plotting capabilities which are readily available on multiple

systems have been added. New and extensive documentation adds comments on program variables and input requirements. Future directions of this research will include comparison of several testing runs with Navier-Stokes calculations. A major interest in this research is to determine the exact effect of free-stream flow angularity. Since wind tunnel test sections are finite in size the effects on flow angularity may not be fully correctable. Shock wave boundary layer interaction is another phenomenon which will limit the capabilities of TWNTN4A. Testing with different size models must be conducted to assess program limitations.
Author
Cryogenics; Wind Tunnel Tests; Transonic Wind Tunnels; Shock Wave Interaction; Navier-Stokes Equation; Kutta-Joukowski Condition; Aerodynamic Interference; Aerodynamic Coefficients; Airfoils

19990019709 Christopher Newport Univ., Dept. of Physics, Computer Science and Engineering, Newport News, VA USA
TIGER MANE: Thermally-Induced Gradient Effects Research, Model Analysis and Nontransferability Evaluation
Hereford, James, Christopher Newport Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 68; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

When wind tunnel measurements are made at non-ambient temperatures (e.g., at the National Transonic Facility), temperature differences on the measurement balance cause a strain that affects the measured load on the model. The strain from the thermal gradient affects all six measurements but its greatest impact is on the axial force (drag) measurement. (Current NTF balances have uncorrected thermal effects of approximately 1% of the full scale component load.) Correction of the thermal gradient effects requires a timely and expensive conditioning process. The goals of this program are to (a) understand the physics of the thermally-induced strain and its subsequent impact on load measurements and (b) develop a robust thermal gradient compensation algorithm. The net effect will be more accurate and precise data, more efficient use of the NTF, and an overall cost savings to NASA. One part of the TIGER program is a Model Assessment and Nontransferability Evaluation (MANE). The goal of MANE is to determine the model for how the temperature gradients affect the strain measurements. In addition, it is important to understand why a model that works well for lab data does not work well when an aircraft model is on the balance (transferability evaluation). The first step was to evaluate a wide assortment of mathematical models to determine how combine the (nine) temperature measurements into a prediction of the output of the axial force. Several models were considered: linear, sin, exponential, natural log, 2d order models and several autoregressive moving average (ARMA) models which take into account past data samples. The ARMA models worked great but are impractical to implement in real-life wind tunnel applications because they would also cancel out a constant applied force. Hence, after considering 14 different models and almost 11,000,000 test cases, we determined a linear combination of temperature sensors gives the best approximation of axial force output. Data analysis from a standard balance with nine temperature sensors does not lead directly to an applicable thermal gradient compensation algorithm. Thus, physical affects of then-nal gradients were considered. From the physical affects, two possible compensation techniques have been determined. The first technique, the front-back technique, determines the impact on the axial force output of a thermal gradient from the front of the balance to the back. (A similar analysis shows that left to right thermal gradients will have no affect on axial force output). The resulting front-back thermal gradient equation gives a clear technique to correct for the gradient once certain key temperatures are known. The second technique, the thermomechanical technique, looks at how thermal gradients will affect the flex beams on the balance. For the simple gradients considered, there is a large difference between how the flex beams deflect when subjected to thermal gradients versus when they are subjected to an applied force. Monitoring the flex beams, therefore, could lead to a thermal gradient compensation technique. to verify these techniques, data from a special research balance must be obtained.
Author
Thermodynamics; Temperature Sensors; Temperature Measurement; Temperature Gradients; Temperature Effects; Drag Measurement; Autoregressive Moving Average; Aircraft Models

19990019723 Christopher Newport Univ., Dept. of Physics, Computer Science and Engineering, Newport News, VA USA
Interface Properties of MEMS Sensors on Airfoil
Selim, Raouf, Christopher Newport Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 83; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

One of the primary goals of wind tunnel groups at NASA Langley Research Center is to reduce wind tunnel cycle time and cost while improving data quality collected during the tests. The objective of the Advanced Model Instrumentation Technology (AMIT) program is to develop a prototype in-model instrumentation system that can be retrofitted into existing models or integrated in new models at the time of their design. The program has three major components: 1) Micro Electro Mechanical Systems (MEMS) sensors (shear stress, pressure, temperature and Angle of attack). 2) In-model electronics (Data acquisition systems and signal conditioning). 3) Data transfer capabilities (Fiber optic or telemetry). MEMS sensors are micron-to-millimeter

scale devices with moving parts or containing fluids, fabricated using semiconductor technologies and often directly connected or integrated with ICs. MEMS Sensor Design covers three areas: 1) Layout and process of the sensor itself. 2) Circuitry for interfacing the system with the sensor. 3) The package that will fit the MEMS sensor into an application. The purpose of this study is to characterize the mechanical interface of MEMS sensors mounted on the surface of the model and test the packaging design under simulated conditions (normal stress, vibration, etc ...). The study included two types of MEMS sensors, namely pressure sensors and shear stress sensors. A measurement system was developed for characterizing the sensors under normal strain and at different temperatures. Each sensor was mounted on a specially designed cantilever beam that has a maximum strain of 1000 micro in/in. The output voltage of the MEMS pressure sensor was measured as a function of applied static pressure and the strain on the beam (at different temperatures). The resistance of four different resistors on the shear stress sensor was measured as a function of the strain on the beam (also at different temperatures). The resistance of four different resistors on the shear stress sensor was measured as a function of the strain on the beam (also at different temperatures). Results of the experiment show that change in the output voltage of the pressure sensor due to strain is less than 80 microvolt and is less than 0.1% of FSO. One can conclude that the strain on the beam has minimal effect on the output of the pressure sensor. Resistance values of the shear stress sensor' resistors increase with the increase in strain. More measurements need to be done to further characterize the relationship between shear stress sensor output and strain on the airfoil. Future studies also may include the effect of pressure and temperature on shear stress sensors.

Author

Airfoils; Angle of Attack; Cantilever Beams; Data Acquisition; Fabrication; Fiber Optics; Microelectromechanical Systems; Millimeter Waves

19990019726 **Hampton Univ., School of Business, VA USA**

Paving the Way for the Wind Tunnel Enterprise at NASA Langley Research Center

Siegfeldt, Denise V., Hampton Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 86; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The Wind Tunnel Enterprise (WTE) at Langley Research Center (LaRC) is a virtual organization comprised of nine Divisions: Aero- and Gas-Dynamics, Facilities & Systems Support, Experimental Testing Technology, Facility Systems Engineering, Information Systems and Services, Fabrication, Fluid Mechanics and Acoustics, and Structures. Wind tunnel facilities within the WTE include the National Transonic Facility and the 0.3M Cryogenic Tunnel. The WTE was envisioned as an organization that would apply business-like principles to its operations and the way in which customers are handled. Strategic planning for the WTE was based upon the cooperative efforts of customers, stakeholders, and producers/ operators of LaRC's wind tunnels. Due to intense global competition, external customers of the wind tunnels had voiced concern that the test cycle time was too long, which delayed the time for new products to reach the market. They were also concerned about the quality of data that they were receiving. Concerns of internal customers were also taken into consideration. WTE's mission is to "provide reliable, accurate research information to the aeronautical community in a timely manner, to accomplish this requires a focus on increasing productivity, cost-effective operations, technical support that adds value, and the development of new facility capability and test techniques." There are many technical, operational, cultural and management goals for the WTE. These goals are designed to enable the WTE to have a positive influence on the bottom-line; namely, increased productivity, data quality, customer satisfaction and employee satisfaction, and decreased cost and cycle time. A major component of the WTE is the proposed Wind Tunnel University (WTU). WTU was the focus of this project and is linked to the VTM cultural goals. The project involved creating a framework for the identification of core competencies (i.e., Tunnel Operations and Wind Tunnel Information Technology) and associated skills through involvement of the WTE Curriculum Committee and interviews with LARC administrators, researchers and technicians. A Gap Analysis Survey was designed to examine gaps that exist between the skills of WTE employees today verses those that are needed. The survey was fine-tuned through use of an electronic meeting with researchers and technicians who are subject matter experts. The survey will be administered through a Web site designed to assure anonymity to individual respondents. Future skill requirements due to cutting edge technologies and those on the horizon will also be identified. Results will provide a snapshot view of the state of the WTE today in terms of employee skills and will suggest the types of training needed. Experts' description's of the skills will be used to develop a course catalog for WTE training at LARC. Metrics will be created to measure the success of each training program. The VITU will serve as a national model for wind tunnel training and is projected to serve outside customers and govenment agencies in the future.

Author

Wind Tunnels; Systems Engineering; Information Systems; Fluid Mechanics; Gas Dynamics

19990021249 Lockheed Martin Engineering and Sciences Co., Hampton, VA USA

A Microsoft Project-Based Planning, Tracking, and Management Tool for the National Transonic Facility's Model Changeover Process

Vairo, Daniel M., Lockheed Martin Engineering and Sciences Co., USA; December 1998; 72p; In English

Contract(s)/Grant(s): NAS1-96014; RTOP 522-31-51-01

Report No.(s): NASA/CR-1998-208968; NAS 1.26:208968; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The removal and installation of sting-mounted wind tunnel models in the National Transonic Facility (NTF) is a multi-task process having a large impact on the annual throughput of the facility. Approximately ten model removal and installation cycles occur annually at the NTF with each cycle requiring slightly over five days to complete. The various tasks of the model changeover process were modeled in Microsoft Project as a template to provide a planning, tracking, and management tool. The template can also be used as a tool to evaluate improvements to this process. This document describes the development of the template and provides step-by-step instructions on its use and as a planning and tracking tool. A secondary role of this document is to provide an overview of the model changeover process and briefly describe the tasks associated with it.

Author

Project Planning; Wind Tunnel Models; Wind Tunnel Tests

19990021489 Logistics Management Inst., McLean, VA USA

Benefit Estimates of Terminal Area Productivity Program Technologies *Final Report*

Hemm, Robert, Logistics Management Inst., USA; Shapiro, Gerald, Logistics Management Inst., USA; Lee, David, Logistics Management Inst., USA; Gribko, Joana, Logistics Management Inst., USA; Glaser, Bonnie, Logistics Management Inst., USA; January 1999; 144p; In English

Contract(s)/Grant(s): NAS2-14361; RTOP 538-16-11-01

Report No.(s): NASA/CR-1999-208989; NAS 1.26:208989; NS809S1; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report documents benefit analyses for the NASA Terminal Area Technology (TAP) technology programs. Benefits are based on reductions in arrival delays at ten major airports over the 10 years from 2006 through 2015. Detailed analytic airport capacity and delay models were constructed to produce the estimates. The goal of TAP is enable good weather operations tempos in all weather conditions. The TAP program includes technologies to measure and predict runway occupancy times, reduce runway occupancy times in bad weather, accurately predict wake vortex hazards, and couple controller automation with aircraft flight management systems. The report presents and discusses the estimate results and describes the models. Three appendixes document the model algorithms and discuss the input parameters selected for the TAP technologies. The fourth appendix is the user's guide for the models. The results indicate that the combined benefits for all TAP technologies at all 10 airports range from $550 to $650 million per year (in constant 1997 dollars). Additional benefits will accrue from reductions in departure delays. Departure delay benefits are calculated by the current models.

Author

Productivity; Airports; Aircraft Landing; Airfield Surface Movements; Aircraft Approach Spacing; Flight Management Systems; Air Traffic Control

19990021656 Brookhaven National Lab., Office of Educational Programs, Upton, NY USA

Preview of NEW: Update 1998

Swyler, Karl J., Brookhaven National Lab., USA; Fine, Leonard W., Columbia Univ., USA; National Educators' Workshop: Update 1997. Standard Experiments in Engineering Materials, Science, and Technology; November 1998, pp. 407-429; In English; See also 19990021619; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

A presentation of the Science Education Center at Brookhaven National Laboratory is given. Details of the Center include: it's Mission, the major facilities there, the organization, and the area of research at the Center.

Derived from text

Education; Knowledge; Science; Laboratories

10
ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

19990024833 Florida Univ., Gainesville, FL USA
Optimization of Turbine Blade Design for Reusable Launch Vehicles *Final Report, 28 Sep. - 31 Dec. 1998*
Shyy, Wei, Florida Univ., USA; 1998; 39p; In English
Contract(s)/Grant(s): NAG8-1251; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

To facilitate design optimization of turbine blade shape for reusable launching vehicles, appropriate techniques need to be developed to process and estimate the characteristics of the design variables and the response of the output with respect to the variations of the design variables. The purpose of this report is to offer insight into developing appropriate techniques for supporting such design and optimization needs. Neural network and polynomial-based techniques are applied to process aerodynamic data obtained from computational simulations for flows around a two-dimensional airfoil and a generic three- dimensional wing/blade. For the two-dimensional airfoil, a two-layered radial-basis network is designed and trained. The performances of two different design functions for radial-basis networks, one based on the accuracy requirement, whereas the other one based on the limit on the network size. While the number of neurons needed to satisfactorily reproduce the information depends on the size of the data, the neural network technique is shown to be more accurate for large data set (up to 765 simulations have been used) than the polynomial-based response surface method. For the three-dimensional wing/blade case, smaller aerodynamic data sets (between 9 to 25 simulations) are considered, and both the neural network and the polynomial-based response surface techniques improve their performance as the data size increases. It is found while the relative performance of two different network types, a radial-basis network and a back-propagation network, depends on the number of input data, the number of iterations required for radial-basis network is less than that for the back-propagation network.
Author
Reusable Launch Vehicles; Turbine Blades; Design Analysis; Optimization; Aerodynamics; Wings; Data Processing

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CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

19990021655 Purdue Univ., Dept. of Mechanical Engineering, Kokomo, IN USA
Corrosion Demonstration Utilizing Low Cost Materials
Williams, John R., Purdue Univ., USA; National Educators' Workshop: Update 1997. Standard Experiments in Engineering Materials, Science, and Technology; November 1998, pp. 397-405; In English; See also 19990021619; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Most of us who live in the midwest are familiar with rusty old vehicles plying our roads, exhibiting the ravages of time and corrosion. Recently, a Russian airliner broke up in mid-air, and investigators believe the failure was caused by corrosion of the aluminum airframe according to USA Today. Engineers and technologists need an introduction to corrosion mechanisms in order to know how to design necessary corrosion prevention techniques into equipment that may be at risk. One source estimates that 20% of the iron and steel products manufactured each year are used to replace things that have been discarded due to rust damage. The author has developed a laboratory exercise that demonstrates the effects of corrosion on metals and also illustrates some methods that can be used to protect metals from the devastation of corrosive attack. Since quantitative corrosion testing takes a long time to achieve measurable results, the qualitative approach taken ensures that the student can observe the effects in a timely manner. In addition, the exercises can be done at minimal cost, a big consideration in these times of shrinking educational budgets.
Derived from text
Corrosion Prevention; Corrosion Tests; Failure; Metals; Iron; Aluminum; Airframes

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ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

19990019718 **New Jersey Inst. of Tech., Dept. of Chemical Engineering, Newark, NJ USA**

Turbulent Jet in a Coflowing Stream

Loney, Norman W., New Jersey Inst. of Tech., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 78; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The testing of aircraft models in a wind tunnel is a mature technology at Langley Research Center. However, the issue of mixing the fuel and an oxygen rich stream in the 8 Ft. High Temperature tunnel is not quite resolved. There are many approaches that can accomplish the task (mixing a hot and cold fluid), but several of those schemes are not suitable for this unique testing facility. Therefore a theoretical investigation is underway to develop a model of a two dimensional turbulent jet in a coflowing stream. This incompressible jet flow will be modeled by employing an integral method which includes turbulent shear stress, entrainment and heat transfer. A commercially available computation fluid dynamics (CFD) code is being used to test the theory since experimental data will not be available from the tunnel. Essentially, one would like to predict the heat transfer to the wall as a function of the jet proximity to that wall, given the size, velocity direction and energy level of the jet.

Author

Aircraft Models; Computational Fluid Dynamics; Energy Levels; Heat Transfer; Incompressible Flow; Turbulence; Turbulent Jets; Wind Tunnel Models

19990019729 **Old Dominion Univ., Dept. of Mechanical Engineering, Norfolk, VA USA**

Detection and Measurement of Hidden Corner Cracks Using a Portable NDI Probe

Williamson, Keith M., Old Dominion Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 89; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

Fatigue damage in aircraft structures increase as airplanes are operated beyond their economic design life, typically 20,000 flight cycles. Reduced durability and safety of these aging structures require elaborate inspection and maintenance to ensure continued airworthiness. Cyclic pressure tests on fuselage structures similar to those found on commercial airliners have enabled researchers to characterize the various forms of fatigue damage. These characterizations show the progression of fuselage skin fatigue cracks from the initial stages of multisite damage (MSD) through crack linkup and widespread fatigue damage (WSFD). Detailed tear down examination and fractography of the lap splice joints have revealed crack initiation sites, crack morphology, and crack linkup geometry. Results of these studies have allowed researchers to benchmark critical laboratory simulations, analytical predictions and advanced nondestructive inspection techniques. Ultimately, the goal is to develop analytical models for estimating the fatigue life of aging structures subject some form of MSD. The quality of analytical models relate directly to types and sizes of cracks which characterize MSD. Although nondestructive inspection (NDI) provides excellent means for detecting flaws, results do not provide data on flaw sizes which are important for characterizing MSD. Generally, NDI results are used to determine the need for repair or to justify airworthiness. Consequently, field data on the sizes of flaws which may define MSD is lacking. The approach used in this investigation is to determine if MSD can be quantified using field data from NDI. During experiments, data will be recorded for quarter-elliptical corner cracks grown from circular holes in 0.63 inch thick aluminum 2024-T3 specimens. After countersinking holes and riveting specimens to hide fatigue crack damage, a portable NDI probe will be used to detect hidden cracks and establish relationships between NDI results and known crack length data.

Author

Aircraft Structures; Aluminum Alloys; Commercial Aircraft; Corners; Countersinking; Crack Geometry; Crack Initiation; Crack Propagation; Lap Joints

19990019859 **NASA Ames Research Center, Moffett Field, CA USA**

Parallel Aeroelastic Analysis Using ENSAERO and NASTRAN

Eldred, Lloyd B., MCAT Inst., USA; Byun, Chansup, MCAT Inst., USA; Guruswamy, Guru P., NASA Ames Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 143-147; In English; See also 19990019831

Contract(s)/Grant(s): NAS2-14109; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

A high fidelity parallel static structural analysis capability is created and interfaced to the multidisciplinary analysis package ENSAERO-MPI of Ames Research Center. This new module replaced ENSAERO's lower fidelity simple finite element and modal modules. Full aircraft structures may be more accurately modeled using the new finite element capability. Parallel computation is performed by breaking the full structure into multiple substructures. This approach is conceptually similar to ENSAERO's multi-zonal fluid analysis capability. The new substructure code is used to solve the structural finite element equations for each substructure in parallel. NASTRAN/COSMIC is utilized as a front end for this code. Its full library of elements can be used to create an accurate and realistic aircraft mode. It is used to create the stiffness matrices for each sub-structure. The new parallel code then uses an iterative preconditioned conjugate gradient method to solve the global structural equations for the sub-structure boundary nodes. Results are presented for a wing-body configuration.
Author
Structural Analysis; Multidisciplinary Design Optimization; Parallel Processing (Computers); Nastran; Computer Techniques; Computation; Body-Wing Configurations; Aeroelasticity

19990019860 NASA Ames Research Center, Moffett Field, CA USA
Performance and Applications of ENSAERO-MPI on Scalable Components
Farhangnia, Mehrdad, MCAT Inst., USA; Guruswamy, Guru, NASA Ames Research Center, USA; Byun, Chansup, Sun Microsystems, Inc., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 149-150; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The latest improvements and results generated by ENSAERO-MPI are presented in this paper. ENSAERO-MPI is a parallelized, high-fidelity, multi-block code with fluids, structures and controls capabilities developed at NASA Ames Research Center under the support of HPCC. It is capable of multidisciplinary simulations by simultaneously integrating the Navier-Stokes equations, the finite element structural equations as well as control dynamics equations using aeroelastically adaptive, patched grids. Improvements have been made to the code's robustness, moving grid capabilities and performance.
Derived from text
Parallel Processing (Computers); Computerized Simulation; Applications Programs (Computers); Navier-Stokes Equation; Multidisciplinary Design Optimization; Aircraft Design; Aircraft Configurations

19990019861 NASA Ames Research Center, Moffett Field, CA USA
OVERAERO-MPI: Parallel Overset Aeroelasticity Code
Gee, Ken, MCAT Inst., USA; Rizk, Yehia M., NASA Ames Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 151-156; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

An overset modal structures analysis code was integrated with a parallel overset Navier-Stokes flow solver to obtain a code capable of static aeroelastic computations. The new code was used to compute the static aeroelastic deformation of an arrow-wing-body geometry and a complex, full aircraft configuration. For the simple geometry, the results were similar to the results obtained with the ENSAERO code and the PVM version of OVERAERO. The full potential of this code suite was illustrated in the complex, full aircraft computations.
Derived from text
Aeroelasticity; Structural Analysis; Navier-Stokes Equation; Computerized Simulation; Parallel Processing (Computers); Aircraft Configurations; Static Deformation; Applications Programs (Computers)

19990019867 NASA Lewis Research Center, Cleveland, OH USA
Inlet-Compressor Analysis using Coupled CFD Codes
Cole, Gary, NASA Lewis Research Center, USA; Suresh, Ambady, DYNACS Engineering Co., Inc., USA; Townsend, Scott, DYNACS Engineering Co., Inc., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 189-195; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Propulsion performance and operability are key factors in the development of a successful aircraft. For high-speed supersonic aircraft, mixed-compression inlets offer high performance but are susceptible to an instability referred to as unstart. An unstart occurs when a disturbance originating in the atmosphere or the engine causes the shock system to be expelled from the inlet. This event can have adverse effects on control of the aircraft, which is unacceptable for a passenger plane such as the high speed civil transport (HSCT). The ability to predict the transient response of such inlets to flow perturbations is, therefore, important to the proper design of the inlet and the control measures used to prevent unstart. Computational fluid dynamics (CFD) is having an increasing role in the analysis of individual propulsion components. Isolated inlet studies are relatively easy to perform, but a major uncertainty is the boundary condition used at the inlet exit to represent the engine - the so-called compressor face boundary condition. A one-dimensional (1-D) Euler inlet simulation showed that the predicted inlet unstart tolerance to free-stream pressure

perturbations can vary by as much as a factor of about six, depending on the boundary condition used. Obviously a thorough understanding of dynamic interactions between inlets and compressors/fans is required to provide the proper boundary condition. to aid in this understanding and to help evaluate possible boundary conditions, an inlet-engine experiment was conducted at the University of Cincinnati. The interaction of acoustic pulses, generated in the inlet, with the engine were investigated. Because of the availability of experimental data for validation, it was decided to simulate the experiment using CFD. The philosophy here is that the inlet-engine system is best simulated by coupling (existing) specialized CFD component-codes. The objectives of this work were to aid in a better understanding of inlet-compressor interaction physics and the formulation of a more realistic compressor-face boundary condition for time-accurate CFD simulations of inlets. Previous simulations have used 1-D Euler engine simulations in conjunction with 1-D Euler and axisymmetric Euler inlet simulations. This effort is a first step toward CFD simulation of an entire engine by coupling multidimensional component codes.
Derived from text
Engine Inlets; Supersonic Compressors; Computational Fluid Dynamics; Flow Stability; Boundary Conditions; Pressure Oscillations; Computerized Simulation; Applications Programs (Computers)

19990021207 **NASA Langley Research Center, Hampton, VA USA**
Residual Strength Pressure Tests and Nonlinear Analyses of Stringer-and Frame-Stiffened Aluminum Fuselage Panels with Longitudinal Cracks
Young, Richard D., NASA Langley Research Center, USA; Rouse, Marshall, NASA Langley Research Center, USA; Ambur, Damodar R., NASA Langley Research Center, USA; Starnes, James H., Jr., NASA Langley Research Center, USA; 1998; 21p; In English; 2nd; Aging Aircraft, 31 Aug. - 3 Sep. 1998, Williamsburg, VA, USA; Sponsored by Department of Defense, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The results of residual strength pressure tests and nonlinear analyses of stringer- and frame-stiffened aluminum fuselage panels with longitudinal cracks are presented. Two types of damage are considered: a longitudinal crack located midway between stringers, and a longitudinal crack adjacent to a stringer and along a row of fasteners in a lap joint that has multiple-site damage (MSD). In both cases, the longitudinal crack is centered on a severed frame. The panels are subjected to internal pressure plus axial tension loads. The axial tension loads are equivalent to a bulkhead pressure load. Nonlinear elastic-plastic residual strength analyses of the fuselage panels are conducted using a finite element program and the crack-tip-opening-angle (CTOA) fracture criterion. Predicted crack growth and residual strength results from nonlinear analyses of the stiffened fuselage panels are compared with experimental measurements and observations. Both the test and analysis results indicate that the presence of MSD affects crack growth stability and reduces the residual strength of stiffened fuselage shells with long cracks.
Author
Fuselages; Aluminum; Residual Strength; Pressure Distribution; Crack Propagation; Axial Loads; Structural Analysis; Load Tests

19990021641 **Norfolk State Univ., Dept. of Technology, VA USA**
Design of Hypervelocity Flow Generator and its Flow Visualizations
Song, Kyo D., Norfolk State Univ., USA; Terrell, Charles, Hampton Univ., USA; Kulick, Mark, NYMA, Inc., USA; National Educators' Workshop: Update 1997. Standard Experiments in Engineering Materials, Science, and Technology; November 1998, pp. 229-253; In English; See also 19990021619; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The generic requirement of advanced hypersonic systems can be found by the flight velocity and altitude trajectories of the anticipated spacecrafts. In the flight corridor of spacecraft, the forebody of a vehicle receives a tremendous thermal loading from its shock layer. The correct estimate of thermal loading is important for optimizing design of the thermal protection system. There has been a recent effort to study the thermophysics of shock heated air in the vicinity of the nose of a vehicle flying at 3-6 km/sec.
Derived from text
Flow Visualization; Hypersonics; Hypervelocity Flow; Shock Heating; Shock Layers; Thermal Protection; Thermodynamics

19990021652 **Purdue Univ. Calumet, Dept. of Mechanical Engineering, Hammond, IN USA**
Life Estimate Based on Fatigue Crack Propagation
Kin, Yulian, Purdue Univ. Calumet, USA; Abramowitz, Harvey, Purdue Univ. Calumet, USA; Hentea, Toma, Purdue Univ. Calumet, USA; Xu, Ying, Purdue Univ. Calumet, USA; National Educators' Workshop: Update 1997. Standard Experiments in Engineering Materials, Science, and Technology; November 1998, pp. 369-380; In English; See also 19990021619; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This experiment is focused on the polycarbonate which is used as a structural component in the F-16 canopy. The aircraft canopy is often manufactured from a laminated composite material. Components of the composite are acrylic plies, a polycarbonate ply, interlayers and coatings. Design of the canopy allows unloading of the acrylic ply and that is why the structural polycarbonate ply of the composite was the primary concern during fatigue investigation. One of the failure modes encountered frequently in the field is polycarbonate fracture. The nature of failures is not quite clear, but some evidence implies that transparency life is limited by fatigue of the polycarbonate ply. Therefore, development of an inspection procedure which permits measurement of a crack and prediction of the part life until its failure is an important task.
Derived from text
Acrylic Resins; Aircraft Structures; Canopies; Composite Materials; Crack Propagation; F-16 Aircraft; Fatigue (Materials); Fracturing; Polycarbonates

19990021666 Lafayette Coll., Skillman Library, Easton, PA USA
Structural Laboratory Manual
Kayser, Jack, Lafayette Coll., USA; National Educators' Workshop: Update 1997. Standard Experiments in Engineering Materials, Science, and Technology; November 1998, pp. 539-601; In English; See also 19990021619; No Copyright; Avail: CASI; A04, Hardcopy; A06, Microfiche

A structural laboratory manual has been written to accompany the laboratory component of a four-credit junior level structural design class at Lafayette College. The manual has been arranged so that hands-on laboratory experiments parallel the textbook material covered in class. Students have consistently written positive comments in their evaluations regarding the clear explanation of the laboratory procedures and the strong correlation between the class, textbook, and laboratory experience.
Derived from text
Manuals; Structural Design; Students; Airframe Materials

19990023263 NASA Goddard Space Flight Center, Greenbelt, MD USA
A Spaceflight Magnetic Bearing Equipped Optical Chopper with Six-Axis Active Control
Blumenstock, Kenneth A., NASA Goddard Space Flight Center, USA; Lee, Kenneth Y., NASA Goddard Space Flight Center, USA; Schepis, Joseph P., NASA Goddard Space Flight Center, USA; 1998; 14p; In English; 6th; Magnetic Bearings, 5-7 Aug. 1998, Cambridge, MA, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper describes the development of an ETU (Engineering Test Unit) rotary optical chopper with magnetic bearings. An ETU is required to be both flight-like, nearly identical to a flight unit without the need for material certifications, and demonstrate structural and performance integrity. A prototype breadboard design previously demonstrated the feasibility of meeting flight performance requirements using magnetic bearings. The chopper mechanism is a critical component of the High Resolution Dynamics Limb Sounder (HIRDLS) which will be flown on EOS-CHEM (Earth Observing System-Chemistry). Particularly noteworthy are the science requirements which demand high precision positioning and minimal power consumption along with full redundancy of coils and sensors in a miniature, lightweight package. The magnetic bearings are unique in their pole design to minimize parasitic losses and utilize collocated optical sensing. The motor is of an unusual disk-type ironless stator design. The ETU design has evolved from the breadboard design. A number of improvements have been incorporated into the ETU design. Active thrust control has been added along with changes to improve sensor stability, motor efficiency, and touchdown and launch survivability. It was necessary to do all this while simultaneously reducing the mechanism volume. Flight-like electronics utilize a DSP (Digital Signal Processor) and contain all sensor electronics and drivers on a single five inch by nine inch circuit board. Performance test results are reported including magnetic bearing and motor rotational losses.
Author
Active Control; Flight Characteristics; Thrust Control; Magnetic Bearings; Digital Systems

19990024873 Analytical Services and Materials, Inc., Hampton, VA USA
Numerical Study of Turbulence Model Predictions for the MD 30P/30N and NHLP-2D Three-Element Highlift Configurations
Morrison, Joseph H., Analytical Services and Materials, Inc., USA; December 1998; 38p; In English
Contract(s)/Grant(s): NAS1-96014
Report No.(s): NASA/CR-1998-208967; NAS 1.26:208967; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report details calculations for the McDonnell-Douglas 30P/30N and the NHLP-2D three-element highlift configurations. Calculations were performed with the Reynolds averaged Navier-Stokes code ISAAC to study the effects of various numerical issues on high lift predictions. These issues include the effect of numerical accuracy on the advection terms of the turbulence equations, Navier-Stokes versus the thin-layer Navier-Stokes approximation, an alternative formulation of the production term,

and the performance of several turbulence models. The effect of the transition location on the NHLP-2D flow solution was investigated. Two empirical transition models were used to estimate the transition location.
Author
Turbulence Models; Airfoils; Reynolds Averaging; Navier-Stokes Equation; Accuracy
DTIC
Oxygen; Chemical Lasers; Lasers; Chemical Oxygen-Iodine Lasers; Diagnosis; Jet Engines; Gas Generators

19990024898 Beijing Univ. of Aeronautics and Astronautics, Dept. of Jet Propulsion, Beijing, China
Control and performance of a turbo-supercharged piston engine
Yan, Chen, Beijing Univ. of Aeronautics and Astronautics, China; Hongming, Wang, Beijing Univ. of Aeronautics and Astronautics, China; Journal of Beijing University of Aeronautics and Astronautics; February 1998; ISSN 1001-5965; Volume 24, No. 1, pp. 16-20; In Chinese; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The principle of control of a turbo-supercharged piston engine with Turbo Control Unit (TCU) is described. The parameters: ambient air pressure, engine speed and the throttle position(T(sub p)) are detected and processed by TCU, which controls the waste gate of turbo-supercharger. The charged air pressure and temperature are fed back. The T(sub p) is set by the pilot. TCU maintains the power of engine under critical altitude and keeps turbo speed beyond it. The engine performance can be calculated under standard and nonstandard atmospheric condition. The results coincide with the datum from the production corp. Bombardier Rotax, Austria, and the performance above critical altitude can be calculated also.
Author
Piston Engines; Superchargers; Control Equipment; Performance Tests

19990024901 Beijing Univ. of Aeronautics and Astronautics, Dept. of Jet Propulsion, Beijing, China
Application of semi-rigid trailing to ram air turbine performance calculating
Jianfeng, Zhang, Beijing Univ. of Aeronautics and Astronautics, China; Siyong, Liu, Beijing Univ. of Aeronautics and Astronautics, China; Journal of Beijing University of Aeronautics and Astronautics; February 1998; ISSN 1001-5965; Volume 24, No. 1, pp. 28-30; In Chinese; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Rigid trailing vortex model consistent with Goldstein hypothesis is often employed in propeller lifting line (lift surface) calculation on the condition of light load, but presents certain error on the condition of heavy load. Semi-rigid trailing vortex model consistent with Theodorsen hypothesis extends Goldstein trailing vortex to heavy load condition. Application of Theodorsen trailing vortex model to ram air turbine lifting line calculation is discussed. A model ram air turbine has been employed to calculate. The results show reasonable distributions of trailing vortex pitch, induced velocities, circulations and blade element wind power utilization coefficient. Wind power utilization coefficient agrees well with experiments.
Author
Turbines; Vortices; Lift

19990024918 Rutgers - The State Univ., Dept. of Mechanical and Aerospace Engineering, Piscataway, NJ USA
Shock Wave Boundary Layer Interactions in High Mach Number Flows: A Critical Survey of Current Numerical Prediction Capabilities
Knight, Doyle D., Rutgers - The State Univ., USA; Degrez, Gerard, Von Karman Inst. for Fluid Dynamics, Belgium; Hypersonic Experimental and Computational Capability, Improvement and Validation; December 1998; Volume 2; 35p; In English; See also 19990024917
Contract(s)/Grant(s): F49620-93-1-0005; RFBR-96-01-01777; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

The report assesses the capability for numerical simulation of 2-D and 3-D shock wave laminar and turbulent boundary layer interactions Three fundamental configurations are considered: single fin, double fin, and hollow cylinder flare. Thirteen separate cases were examined by a distinguished international group of researchers using the Reynolds-averaged Navier-Stokes (RANS) equations with a wide range of turbulence models from zero equation to full Reynolds Stress Equation formulations. The report presents an extensive comparison of computations and experimental data, summarizes the results, and makes recommendations for future research.
Author
Fins; Laminar Boundary Layer; Mach Number; Navier-Stokes Equation; Reynolds Averaging; Reynolds Equation; Turbulence Models; Turbulent Boundary Layer; Computational Fluid Dynamics; Flared Bodies; Shock Waves

19990024921 NASA Ames Research Center, Moffett Field, CA USA
Real Gas/Blunt Cone, Phase 2
Deiwert, George S., NASA Ames Research Center, USA; Eitelberg, Georg, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Hypersonic Experimental and Computational Capability, Improvement and Validation; December 1998; Volume 2; 21p; In English; See also 19990024917; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

In this chapter recent activity in real-gas database definition and code validation will be summarized. In the Phase I report of the Working Group (WG) 181, aerothermodynamic problems were classified, for purpose of discussion, into seven types: aerodynamic parameters, viscous/shock interaction, boundary-layer transition, forebody-heating/heat-transfer, radiation and ablation, lee and base-region flow, and low-density flow. Several of these problem types were the subject of various chapters of the Phase 1 report describing real-gas effects and ground test facility issues. In this chapter some background and objectives outlined in the real-Gas effects Chapter V of the Phase 1 report will be reviewed. The results of the blunt cone test campaign developed under the auspices of the WG18 activity to study real-gas phenomena will be summarized, including the experimental and computational programs, issues and questions, and recommendations. Further, recent progress in other real-gas areas beyond the blunt cone test campaign will be discussed. Finally, a summary in which the present status of our understanding of real-gas issues will be presented.

Derived from text

Aerothermodynamics; Heat Transfer; Real Gases; Computational Fluid Dynamics; Hypersonic Flow; Blunt Bodies; Cones; Enthalpy; Nitrogen; Navier-Stokes Equation; Oxygen; Wind Tunnel Tests

19990025175 Ben Gurion Univ. of the Negev, Beersheva Israel
Diagnostics of Chemical Oxygen-Iodine Lasers Energized by Singlet Oxygen Jet-Generators *Final Report*
Rosenwaks, Salman, Ben Gurion Univ. of the Negev, Israel; Dec. 1998; 43p; In English
Contract(s)/Grant(s): F61708-96-C-0005
Report No.(s): AD-A359164; EOARD-SPC96-4078; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report results from a contract tasking Ben-Gurion University of the Negev as follows: The contractor will carry out diagnostic measurements in a small-scale supersonic chemical oxygen-iodine laser (COIL) with transonic mixing, energized by a singlet oxygen jet- generator (JSOG). They will use a three diode laser-based diagnostic system for oxygen, water, and iodine and measure the oxygen singlet yield and water vapor fraction at the exit of the JSOG and the gain in the resonator.

13
GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

DTIC

Wind Velocity; Altimeters; Climatology; Evaluation; Spaceborne Experiments

19990019720 Cumberland Coll., Dept. of Mathematics, Physics and Geography, Williamsburg, KY USA
Organizing and Analyzing Lidar Data Obtained From the Contrails of a Boeing 737
Newquist, Lawrence A., Cumberland Coll., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 80; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

With the production of the High Speed Civil Transport (HSCT) , which will fly in the stratosphere, comes a need to monitor the emissions from these aircraft. With the presence of the ozone layer at the top of the stratosphere, it is important to study the composition and evolution of these emissions as well as the circulation of these emissions throughout the stratosphere to understand their impact on the stratosphere and the ozone layer. In experiments carried out in 1995, 1996, and 1997, a 48 inch zenith Lidar (Light Detection and Ranging) system and a scanning Lidar system were used to detect the backscatter radiation from the contrails of a Boeing 737 jet aircraft as the plumes were advected across the Lidar systems. Radiation at wavelengths of 1064 nm and 532 nm was used on the 48 inch system. Only radiation at 1064 nm was used on the scanning system. This data needs to be processed and organized into a uniform format since the formats changed over the three years due to better ways to acquire and store the data. Also, for some runs, two lasers each running at 10 Hz were interleaved to generate 20 Hz data. Methods for correctly interleaving the two laser signals will be studied. The data then needs to be posted to the Web to make it available to the scientific community. Analysis of this data will include calculating the ratio of the 532 nm return to the 1064 nm return. This will be referred to as the beta ratio since it is essentially the ratio of the backscatter cross sections (typically symbolized using the Greek letter beta)

for the two wavelengths. Since small particles will scatter 532 nm radiation more efficiently then 1064 nm radiation a large beta ratio could be indicative of regions of small particle formation which could indicate interesting chemistry within the plume region.
Author
Boeing 737 Aircraft; Optical Radar; Lasers; Supersonic Transports

19990019894 Atmospheric and Environmental Research, Inc., Cambridge, MA USA
Transport Between the Tropical and Midlatitude Lower Stratosphere: Implications for Ozone Response to High Speed Civil Transport Emissions
Shia, R.-L., Atmospheric and Environmental Research, Inc., USA; Ko, M. K. W., Atmospheric and Environmental Research, Inc., USA; Weisenstein, D. K., Atmospheric and Environmental Research, Inc., USA; Scott, C., Atmospheric and Environmental Research, Inc., USA; Rodriquez, J., Atmospheric and Environmental Research, Inc., USA; Journal of Geophysical Research; Oct. 20, 1998; ISSN 0148-0227; Volume 103, No. D19, pp. 25,435-25,446; In English
Contract(s)/Grant(s): NAS5-32371; NAS5-97039
Report No.(s): Paper-98JD01882; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Several recent studies have quantified the air exchange rate between the tropics and midlatitudes in the lower stratosphere using airborne and satellite measurements of chemical species. It is found that the midlatitude air is mixed into the tropical lower stratosphere with a replacement timescale of 13.5 months (with 20% uncertainty) for the region from the tropopause to 21 km and at least 18 months for the region of 20-28 km. These estimates are used to adjust the horizontal eddy diffusion coefficients, K(sub yy), in a two-dimensional chemistry transport model. The value of K(sub yy) previously used to simulate the subtropical barrier, 0.03 x 10(exp 6)sq m/s, generates an exchange time of about 4 years, and the model without subtropical barrier (K(sub yy) = 0.3 x 10(exp 6)sq m/s) has an exchange time of 5 months. Adjusting the K(sub yy) to 0.13 x 10(exp 6) sq m/s from the tropopause to 21 km and 0.07 x 10(exp 6)sq m/s above 21 km produces the exchange timescales which match the estimates deduced from the measurements. The subtropical barrier prevents the engine emissions of the high-speed civil transport (HSCT) aircraft from being transported into the tropics and subsequently lifted into the upper atmosphere or mixed into the southern hemisphere. The model results show that the calculated ozone response to HSCT aircraft emissions using the K(sub yy), adjusted to observed mixing rates is substantially smaller than that simulated without the subtropical barrier.
Author
Exhaust Emission; Supersonic Transports; Tropical Regions; Transport Aircraft; Exhaust Gases; Temperate Regions; Combustion Products; Ozone; Stratosphere

19990019895 NASA Goddard Space Flight Center, Greenbelt, MD USA
Aviation Fuel Tracer Simulation: Model Intercomparison and Implications
Danilin, M. Y., Atmospheric and Environmental Research, Inc., USA; Fahey, D. W., National Oceanic and Atmospheric Administration, USA; Schumann, U., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Prather, M. J., California Univ., USA; Penner, J. E., Michigan Univ., USA; Ko, M. K. W., Atmospheric and Environmental Research, Inc., USA; Weisenstein, D. K., Atmospheric and Environmental Research, Inc., USA; Jackman, C. H., NASA Goddard Space Flight Center, USA; Pitari, G., Aquila Univ., Italy; Koehler, I., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Sausen, R., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Weaver, C. J., NASA Goddard Space Flight Center, USA; Douglass, A. R., NASA Goddard Space Flight Center, USA; Connell, P. S., Lawrence Livermore National Lab., USA; Kinnison, D. E., Lawrence Livermore National Lab., USA; Dentener, F. J., Utrecht Univ., Netherlands; Fleming, E. L., NASA Goddard Space Flight Center, USA; Berntsen, T. K., Center for International Climate and Environmental Research, Norway; Isaksen, I. S. A., Oslo Univ., Norway; Geophysical Research Letters; Nov. 01, 1998; ISSN 0094-8276; Volume 25, No. 21, pp. 3947-3950; In English
Report No.(s): Paper-GRL-1998900058; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An upper limit for aircraft-produced perturbations to aerosols and gaseous exhaust products in the upper troposphere and lower stratosphere (UT/LS) is derived using the 1992 aviation fuel tracer simulation performed by eleven global atmospheric models. Key findings are that subsonic aircraft emissions: (1) have not been responsible for the observed water vapor trends at 40degN; (2) could be a significant source of soot mass near 12 km, but not at 20 km; (3) might cause a noticeable increase in the background sulfate aerosol surface area and number densities (but not mass density) near the northern mid-latitude tropopause; and (4) could provide a global, annual mean top of the atmosphere radiative forcing up to +0.006 W/sq m and -0.013 W/sq m due to emitted soot and sulfur, respectively.
Author
Atmospheric Models; Aircraft Fuels; Aerosols; Perturbation; Combustion Products; Exhaust Emission; Simulation

19990021032 Clark Univ., Graduate School of Geography, Worcester, MA USA
High Resolution Airborne Digital Imagery for Precision Agriculture
Herwitz, Stanley R., Clark Univ., USA; Oct. 1998; 3p; In English; See also 19990021025; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The Environmental Research Aircraft and Sensor Technology (ERAST) program is a NASA initiative that seeks to demonstrate the application of cost-effective aircraft and sensor technology to private commercial ventures. In 1997-98, a series of flight-demonstrations and image acquisition efforts were conducted over the Hawaiian Islands using a remotely-piloted solar- powered platform (Pathfinder) and a fixed-wing piloted aircraft (Navajo) equipped with a Kodak DCS450 CIR (color infrared) digital camera. As an ERAST Science Team Member, I defined a set of flight lines over the largest coffee plantation in Hawaii: the Kauai Coffee Company's 4,000 acre Koloa Estate. Past studies have demonstrated the applications of airborne digital imaging to agricultural management. Few studies have examined the usefulness of high resolution airborne multispectral imagery with 10 cm pixel sizes. The Kodak digital camera integrated with ERAST's Airborne Real Time Imaging System (ARTIS) which generated multiband CCD images consisting of 6 x 106 pixel elements. At the designated flight altitude of 1,000 feet over the coffee plantation, pixel size was 10 cm. The study involved the analysis of imagery acquired on 5 March 1998 for the detection of anomalous reflectance values and for the definition of spectral signatures as indicators of tree vigor and treatment effectiveness (e.g., drip irrigation; fertilizer application).

Derived from text

High Resolution; Research Aircraft; Airborne Equipment; Imaging Techniques; Charge Coupled Devices

19990021035 Nevada Univ., Dept. of Civil Engineering, Las Vegas, NV USA
Proposed Wind Turbine Aeroelasticity Studies Using Helicopter Systems Analysis
Ladkany, Samaan G., Nevada Univ., USA; Oct. 1998; 3p; In English; See also 19990021025; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Advanced systems for the analysis of rotary wing aeroelastic structures (helicopters) are being developed at NASA Ames by the Rotorcraft Aeromechanics Branch, ARA. The research has recently been extended to the study of wind turbines, used for electric power generation Wind turbines play an important role in Europe, Japan & many other countries because they are non polluting & use a renewable source of energy. European countries such as Holland, Norway & France have been the world leaders in the design & manufacture of wind turbines due to their historical experience of several centuries, in building complex wind mill structures, which were used in water pumping, grain grinding & for lumbering. Fossil fuel cost in Japan & in Europe is two to three times higher than in the USA due to very high import taxes. High fuel cost combined with substantial governmental subsidies, allow wind generated power to be competitive with the more traditional sources of power generation. In the USA, the use of wind energy has been limited mainly because power production from wind is twice as expensive as from other traditional sources. Studies conducted at the National Renewable Energy Laboratories (NREL) indicate that the main cost in the production of wind turbines is due to the materials & the labor intensive processes used in the construction of turbine structures. Thus, for the US to assume world leadership in wind power generation, new lightweight & consequently very flexible wind turbines, that could be economically mass produced, would have to be developed [4,5]. This effort, if successful, would result in great benefit to the US & the developing nations that suffer from overpopulation & a very high cost of energy.

Author

Wind Turbines; Aeroelasticity; Rotary Wings; Research; Rotary Wing Aircraft

19990021466 Naval Research Lab., Ocean Sciences Branch, Bay Saint Louis, MS USA
Technical Evaluation of Constructing Wind and Wave Climatologies Using Spaceborne Altimeter Output with a Demonstration Study in the Yellow and East China Seas *Final Report*
Hwang, Paul A., Naval Research Lab., USA; Teaque, William J., Naval Research Lab., USA; Nov. 10, 1998; 43p; In English
Contract(s)/Grant(s): N6230698WR80110; W81EWF81381320
Report No.(s): AD-A358689; NRL/MR/7332-98-8216; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The density of data output from spaceborne altimeters is an impressive 7-km alongtrack. This is an excellent data source to the study of global and regional wind and wave conditions. A technical evaluation of constructing regional climatologies of winds and waves is presented. The accuracy of the measurements is summarized from several earlier comparison studies. The results indicate that the wind speeds and wave heights measured by satellite altimeters are of outstanding quality. For the construction of a regional climatology, the spatial resolution (grid size) and temporal resolution (time bin) are important considerations. Our analysis indicates that from a single satellite seasonal statistics with 1 degree resolution can be achieved. With combined satellite output, monthly climatologies with 0.25 degree resolution is possible. A demonstration study is presented for the region of Yellow and East China Seas using the TOPEX output. The results show significant temporal and spatial structure of the wind and wave

distributions in the region. Four distinct domains of winds and waves can be defined for the area defined by (115 degree E, 20 degree N) and (130 degree E, 42 degree N): the Yellow Sea, the East China Sea, the Kuroshio, and South of Ryukyu Islands. The distinction of each area is outlined.

15
MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

19990019667 NASA Goddard Space Flight Center, Greenbelt, MD USA
Evolving the Reuse Process at the Flight Dynamics Division (FDD) Goddard Space Flight Center
Condon, S., Computer Sciences Corp., USA; Seaman, C., Maryland Univ., USA; Basili, Victor, Maryland Univ., USA; Kraft, S., NASA Goddard Space Flight Center, USA; Kontio, J., Maryland Univ., USA; Kim, Y., Maryland Univ., USA; Software Engineering Laboratory Series: Proceedings of the Twenty-First Annual Software Engineering Workshop; Dec. 1996, pp. 27-58; In English; See also 19990019665; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents the interim results from the Software Engineering Laboratory's (SEL) Reuse Study. The team conducting this study has, over the past few months, been studying the Generalized Support Software (GSS) domain asset library and architecture, and the various processes associated with it. In particular, we have characterized the process used to configure GSS-based attitude ground support systems (AGSS) to support satellite missions at NASA's Goddard Space Flight Center. to do this, we built detailed models of the tasks involved, the people who perform these tasks, and the interdependencies and information flows among these people. These models were based on information gleaned from numerous interviews with people involved in this process at various levels. We also analyzed effort data in order to determine the cost savings in moving from actual development of AGSSs to support each mission (which was necessary before GSS was available) to configuring AGSS software from the domain asset library. While characterizing the GSS process, we became aware of several interesting factors which affect the successful continued use of GSS. Many of these issues fall under the subject of evolving technologies, which were not available at the inception of GSS, but are now. Some of these technologies could be incorporated into the GSS process, thus making the whole asset library more usable. Other technologies are being considered as an alternative to the GSS process altogether. In this paper, we outline some of issues we will be considering in our continued study of GSS and the impact of evolving technologies.

Author

Software Engineering; Computer Programs; Computer Programming; Aerodynamics; Software Reuse

19990019681 Naval Research Lab., Center for High Assurance Computer Systems, Washington, DC USA
Applying the SCR Requirements Specification Method to Practical Systems: A Case Study
Bharadwaj, Ramesh, Naval Research Lab., USA; Heitmeyer, Connie, Naval Research Lab., USA; Software Engineering Laboratory Series: Proceedings of the Twenty-First Annual Software Engineering Workshop; Dec. 1996, pp. 353-376; In English; See also 19990019665; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Studies have shown that the majority of errors in software systems are due to incorrect requirements specifications. The root cause of many requirements errors is the imprecision and ambiguity that arise because the software requirements are expressed in natural language. An effective way to reduce such errors is to express requirements in a formal notation. For a number of years, researchers at the Naval Research Laboratory (NRL) have been working on a formal method based on tables to specify the requirements of practical systems. Known as the Software Cost Reduction (SCR) method, this approach was originally formulated to document the requirements of the Operational Flight Program (OFP) for the U.S. Navy's A-7 aircraft. Since SCR's introduction more than a decade ago, many industrial organizations, including Lockheed, Grumman, and Ontario Hydro, have used SCR to specify requirements. Recently, NRL has developed both a formal state machine model to define the SCR semantics and a set of software tools to support analysis and validation of SCR requirements specifications. The tools support consistency and completeness checking, simulation, and model checking.

Derived from text

A-7 Aircraft; Computer Programming; Computer Programs; Natural Language (Computers); Simulation; Software Engineering

19990019697 Purdue Univ., School of Aeronautics and Astronautics, West Lafayette, IN USA
Genetic Algorithm Actuator Placement for Flow Control for Maneuverability
Crossley, William A., Purdue Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 54; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy;

A02, Microfiche; Abstract Only; Abstract Only

The Aircraft Morphing program is an effort to develop smart devices for aircraft applications, making use of active component technologies. One of the technology areas for this program is Multidisciplinary Design Optimization (MDO), and a focus effort in MDO is to investigate and subsequently develop methods for optimal placement of sensors and actuators for aeroelastic control, flow control and acoustic control. A promising approach for actuator placement is the Genetic Algorithm (GA), a global optimization technique well suited to discrete optimization. Smart devices that can produce a quasi-static shape change in an aircraft wing may be able to provide three-axis flight control; this could eliminate the need for conventional control surfaces. Surfaces like ailerons, flaps, etc., have gaps between the wing and the surfaces that contribute to leakage and protuberance drag and can be a source of aerodynamic noise. The focus of this study was to investigate GA approaches to place discrete actuators on a wing to provide three- axis flight control. The genetic algorithm is a computational representation of natural selection and reproduction observed in biological populations. The mimicry of nature in a GA includes representing points in a design space as if they were individual organisms. Design variables are generally mapped into binary strings that provide the genes of a given design. These strings are then concatenated to form a chromosome representing the traits of an individual design point. The GA works with these binary chromosomes, which allows for discrete optimization. In this application, the binary " 1 " represented an "on" actuator, while the "O" represented an "off " actuator. A problem description was developed for a "three-condition" flight control design, where the number of unique actuators is to be minimized, subject to constraints on the pitch, roll and yaw moments. The first condition is a "pitch" condition where a limit is placed upon the pitching moment to reflect a pitch capability and limits are placed upon the magnitude of the roll and yaw moments to ensure that the pitching motion is uncoupled from roll and yaw. The other two conditions provide for uncoupled roll and yaw. The genetic algorithm determined actuator placements to meet the pitch condition for a simplified untapered, unswept wing. A 3-D panel code predicted aerodynamic force and moment coefficients for the various actuator placements. Results of this work have illustrated that the GA is suited to the task of actuator placement, and these results have highlighted areas for future research and development of this approach.

Author

Actuators; Aeroelasticity; Control Surfaces; Design Analysis; Flight Control; Multidisciplinary Design Optimization

19990021254 Rockwell Collins, Inc., Advanced Technology Center, Cedar Rapids, IA USA

Detecting Mode Confusion Through Formal Modeling and Analysis, Phase 1 *Final Report*

Miller, Steven P., Rockwell Collins, Inc., USA; Potts, James N., Rockwell Collins, Inc., USA; January 1999; 68p; In English

Contract(s)/Grant(s): NAS1-19704; RTOP 522-33-31-01

Report No.(s): NASA/CR-1999-208971; NAS 1.26:208971; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Aircraft safety has improved steadily over the last few decades. While much of this improvement can be attributed to the introduction of advanced automation in the cockpit, the growing complexity of these systems also increases the potential for the pilots to become confused about what the automation is doing. This phenomenon, often referred to as mode confusion, has been involved in several accidents involving modem aircraft. This report describes an effort by Rockwell Collins and NASA Langley to identify potential sources of mode confusion through two complementary strategies. The first is to create a clear, executable model of the automation, connect it to a simulation of the flight deck, and use this combination to review of the behavior of the automation and the man-machine interface with the designers, pilots, and experts in human factors. The second strategy is to conduct mathematical analyses of the model by translating it into a formal specification suitable for analysis with automated tools. The approach is illustrated by applying it to a hypothetical, but still realistic, example of the mode logic of a Flight Guidance System.

Author

Human Factors Engineering; Man Machine Systems; Aircraft Safety; Cockpits

16
PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

19990019703 Midwestern State Univ., Wichita Falls, TX USA

Review and Extension of the Definition of the Acoustic Energy in Inhomogeneous Moving Media

Farris, Mark, Midwestern State Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 61; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The acoustic energy in a moving inhomogeneous medium is a very useful tool for application to many problems of aeroacoustics such as ducted fans, helicopter rotors and high speed propellers. Intuitively, one expects that some conservation laws hold far an energy quantity. We could then use energy conservation laws to understand and control the noise level of these machines in the near and far fields. The concept of the acoustic energy in a moving medium is particularly useful in active noise control of ducted fan engines because the transducers used for noise control operate in a nonlinear flow regime. ne amount of energy needed by the transducers to affect the radiated noise of these engines can then be calculated precisely. The definition of acoustic energy in moving media is complicated because of the fact that there are three kinds of perturbation that propagate in inhomogeneous moving media. These are acoustic, vortical and entropic perturbations that travel at different speed in the fluid medium. Furthermore, the task of the definition of an acoustic energy expression is difficult because of the interaction between these three perturbation modes and the transfer of the acoustic energy to the mean flow. This investigation involves a review of the current state of the knowledge of the acoustic energy in inhomogeneous moving media. The basic energy conservation law is interpreted in several forms that may prove to be useful in isolating the acoustic energy and its interaction with the background flow.

Author

Acoustic Emission; Aeroacoustics; Conservation Laws; Energy Conservation; Near Fields; Noise Intensity; Noise Reduction; Rotary Wings; Sound Waves

19990021022 **Virginia Polytechnic Inst. and State Univ., Vibration and Acoustics Labs., Blacksburg, VA USA**

Hybrid Active-Passive Systems for Control of Aircraft Interior Noise *Final Report, 16 Jan. 1998 - 15 Jan. 1999*

Fuller, Chris R., Virginia Polytechnic Inst. and State Univ., USA; 1999; 3p; In English

Contract(s)/Grant(s): NCC1-282

Report No.(s): VPI/SU-FRS-4-26459; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Previous work has demonstrated the large potential for hybrid active-passive systems for attenuating interior noise in aircraft fuselages. The main advantage of an active-passive system is, by utilizing the natural dynamics of the actuator system, the control actuator power and weight is markedly reduced and stability/robustness is enhanced. Three different active-passive approaches were studied in the past year. The first technique utilizes multiple tunable vibration absorbers (ATVA) for reducing narrow band sound radiated from panels and transmitted through fuselage structures. The focus is on reducing interior noise due to propeller or turbo fan harmonic excitation. Two types of tunable vibration absorbers were investigated; a solid state system based upon a piezoelectric mechanical exciter and an electromechanical system based upon a Motran shaker. Both of these systems utilize a mass-spring dynamic effect to maximize tile output force near resonance of the shaker system and so can also be used as vibration absorbers. The dynamic properties of the absorbers (i.e. resonance frequency) were modified using a feedback signal from an accelerometer mounted on the active mass, passed through a compensator and fed into the drive component of the shaker system (piezoelectric element or voice coil respectively). The feedback loop consisted of a two coefficient FIR filter, implemented on a DSP, where the input is acceleration of tile ATVA mass and the output is a force acting in parallel with the stiffness of the absorber. By separating the feedback signal into real and imaginary components, the effective natural frequency and damping of the ATVA can be altered independently. This approach gave control of the resonance frequencies while also allowing the simultaneous removal of damping from the ATVA, thus increasing the ease of controllability and effectiveness. In order to obtain a "tuned" vibration absorber the chosen resonant frequency was set to the excitation frequency. In order to minimize sound radiation a gradient descent algorithm was developed which globally adapted the resonance frequencies of multiple ATVA's while minimizing a cost based upon the radiated sound power or sound energy obtained from an array of microphones.

Derived from text

Noise Reduction; Dynamic Characteristics; Aircraft Noise; Aircraft Compartments; Controllability

19990024834 **Florida State Univ., Dept. of Mathematics, Tallahassee, FL USA**

Jet Aeroacoustics: Noise Generation Mechanism and Prediction *Progress Report, 1 Jan. - 31 Dec. 1998*

Tam, Christopher, Florida State Univ., USA; 1998; 16p; In English

Contract(s)/Grant(s): NAG1-1776; NAG3-1683; NAG3-2102; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report covers the third year research effort of the project. The research work focussed on the fine scale mixing noise of both subsonic and supersonic jets and the effects of nozzle geometry and tabs on subsonic jet noise. In publication 1, a new semi-empirical theory of jet mixing noise from fine scale turbulence is developed. by an analogy to gas kinetic theory, it is shown that the source of noise is related to the time fluctuations of the turbulence kinetic theory. On starting with the Reynolds Averaged Navier-Stokes equations, a formula for the radiated noise is derived. An empirical model of the space-time correlation function of the turbulence kinetic energy is adopted. The form of the model is in good agreement with the space-time two-point velocity correlation function measured by Davies and coworkers. The parameters of the correlation are related to the parameters of the k-epsilon turbulence model. Thus the theory is self-contained. Extensive comparisons between the computed noise spectrum of

the theory and experimental measured have been carried out. The parameters include jet Mach number from 0.3 to 2.0 and temperature ratio from 1.0 to 4.8. Excellent agreements are found in the spectrum shape, noise intensity and directivity. It is envisaged that the theory would supercede all semi-empirical and totally empirical jet noise prediction methods in current use.
Derived from text
Aeroacoustics; Noise Prediction; Jet Aircraft Noise; Subsonic Flow; Noise Intensity; Noise Generators

19990024836 Beijing Univ. of Aeronautics and Astronautics, Dept. of Applied Mathematics and Physics, Beijing, China
Acoustic emission apparatus for rubbing diagnosis of large rotating machinery
Jian, Wu, Beijing Univ. of Aeronautics and Astronautics, China; Jiahui, Liang, Beijing Univ. of Aeronautics and Astronautics, China; Huailing , Li, Beijing Research Inst. of Machinery Design, China; Journal of Beijing University of Aeronautics and Astronautics; February 1998; ISSN 1001-5965; Volume 24, No. 1, pp. 104-107; In Chinese; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

In large rotating machinery using filmatic bearing (turbogenerator, air compressor, etc.) there is potential trouble from imperfect installation or running conditions, a metals' contact between rotors and shells. The trouble is usually called rubbing. The advantage of AE technology in the rubbing diagnosis and early detection is showed. Instead of classical AE characteristic parameters (counts, amplitude, energy, duration and the others) a new feature extraction by frequency analysis of AE envelop signals is discussed. Both research of AE process and field experiments indicate that periodic components in the envelop spectrum related to rotational speed increase evidently at the beginning of rubbing production, hence are highly sensitive to the rubbing fault diagnosis. According to the new design an acoustic emission equipment for the rubbing diagnosis named BUAA AE testing system is developed and described.
Author
Acoustic Emission; Error Analysis; Rotation; Turbogenerators; Compressors

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SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

19990019690 Hampton Univ., VA USA
1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program
Marable, William P., Compiler, Hampton Univ., USA; Murray, Deborah B., Compiler, Old Domini[illegible] USA; Dec. 1998; 119p; In English; 34th, 1 Jun. - 7 Aug. 1998, Hampton, VA, USA; Sponsored by American Societ[illegible]eering Education, USA; See also 19990019691 through 19990019729
Contract(s)/Grant(s): NGT1-52181
Report No.(s): NASA/CR-1998-208728; NAS 1.26:208728; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche; Abstracts Only; Abstracts Only

Since 1964, the National Aeronautics and Space Administration (NASA) has supported a program of summer faculty fellowships for engineering and science educators. In a series of collaborations between NASA research and development centers and nearby universities, engineering faculty members spend 10 weeks working with professional peers on research. The Summer Faculty Program Committee of the American Society for Engineering Education supervises the programs. The program objectives include: (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate and exchange ideas between participants and NASA; (3) to enrich and refresh the research and teaching activities of participants' institutions; (4) To contribute to the research objectives of the NASA center. College or university faculty members will be appointed as Research Fellows to spend 10 weeks in cooperative research and study at the NASA Langley Research Center. The Fellow will devote approximately 90 percent of the time to a research problem and the remaining time to a study program. The study program will consist of lectures and seminars on topics of interest or that are directly relevant to the Fellows' research topics. The lecture and seminar leaders will be distinguished scientists and engineers from NASA, education, and industry.
Author
Aeronautical Engineering; NASA Programs; University Program; Conferences

19990019707 Christopher Newport Univ., Dept. of Physics and Computer Science, Newport News, VA USA
NASA Educator Workshop (NEW) Abstract
Hale, L. Vincent, Christopher Newport Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 66; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

This summer 20 K-12 grade teachers traded in chalkboards, hall passes, and dismissal bells for wind tunnel tests, flight simulators, and aeronautic-related briefings as they attended a 2 week NASA Educator Workshop (NEW). The objectives of NEW were to share information about NASA resources, programs, and services, to provide an opportunity for the teams of educators to develop and implement an action plan that will support standards-based teaching and learning of science, mathematics, and technology in a problem-based learning (PBL) environment, to strengthen partnership with NASA by sustaining interaction and collaboration, and to provide an opportunity for the teams to exchange ideas.
Derived from text
Research and Development; NASA Programs; Flight Simulators; Education

19990025010 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
Functions for Writing and Reading Time History Data
Brian, Geoff, Defence Science and Technology Organisation, Australia; Jun. 1998; 88p; In English
Report No.(s): DSTO-GD-0183; DODA-AR-010-553; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria, Australia 3001), Hardcopy, Microfiche

The manipulation of time history data is one of the most common activities conducted when analysing aircraft flight behaviour and performance, and as a result there exists a multitude of data formats individualized for specific applications. Air Operations Division (AOD), of the Defence Science and Technology Organization, have chosen to support two time history data formats defined by NASA Dryden Flight Research Center for development of flight behaviour and performance applications. A suite of functions for writing and reading the selected NASA time history data formats have been developed at AOD. These functions may be incorporated into analysis applications to reduce development time for new software, and to improve the sharing of data between applications.
Author
Technologies; Reading; Flight Characteristics; Data Bases

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GENERAL

19990019751 Air Force Research Lab., Wright-Patterson AFB, OH USA
JAWS S3 98 Conference Las Vegas, NV 15-18 June 98 Volume 3
Jun. 1998; 496p; In English
Report No.(s): AD-A356185; No Copyright; Avail: CASI; A21, Hardcopy; A04, Microfiche

This report contains presentations from the JAWS S3 98 Conference. Topics include: (1) meeting technology needs of the warfighter Y2K and beyond, (2) embedded computer resources, (3) ordnance on target, (4) information technology and Naval aviation, (5) Army technology thrusts, (6) EW threat simulation, (7) ASW acoustic sensors, (8) software technology, (9) avionics, and (10) electronic combat.
DTIC
Conferences; Software Engineering; Avionics; Electronic Warfare

19990019752 Air Force Research Lab., Wright-Patterson AFB, OH USA
JAWS S3 98 Conference Las Vegas, NV 15-18 June 98 Volume 2
Jun. 1998; 427p; In English
Report No.(s): AD-A356186; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

This report contains presentations from the JAWS S3 98 Conference. Topics include: (1) avionics, (2) EPA issues, (3) atmospheric support for ground systems hit avoidance, (4) target to sensor vision, (5) sensor vision in degraded environments, (6) electronic warfare testing, (7) computerized simulation, (8) cost reduction methods for aircraft weapon acquisition, (9) software engineering, (10) electronic protection radio, and (11) preflight integration of munitions and electronic systems.
DTIC
Conferences; Avionics; Software Engineering; Computerized Simulation; Target Acquisition; Weather

19990019753 Air Force Research Lab., Wright-Patterson AFB, OH USA
JAWS S3 98 Conference Las Vegas, NV 15-18 June 98 Volume 1
Jun. 1998; 391p; In English
Report No.(s): AD-A356187; No Copyright; Avail: CASI; A17, Hardcopy; A04, Microfiche

This report contains presentations from the JAWS S3 98 Conference. Topics include: (1) data compression, (2) fault tolerant computing, (3) partitioning protocol for systems integration, (4) relational avionics planning tool, (5) using RMA on an avionics product development life cycle, (6) legacy programs modeling and simulation, (7) information fusion, (8) SAR ATR algorithms, (9) software engineering, (10) electromagnetic radiation modeling, (11) real time embedded systems, (12) computer displays, and (13) distributed simulation testing.
DTIC
Conferences; Data Compression; Embedded Computer Systems; Computer Systems Design; Computer Programming; Fault Tolerance; Systems Integration; Avionics; Computerized Simulation

19990021535 NASA Langley Research Center, Hampton, VA USA
Journey in Aeronautical Research: A Career at NASA Langley Research Center, No. 12, Monographs in Aerospace History
Phillips, W. Hewitt, NASA Langley Research Center, USA; Nov. 1998; 216p; In English; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

An autobiography, of a noted aeronautical engineer, W. Hewitt Phillips, whose career spanned 58 years (1940-1998) at NASA Langley is presented. This work covers his early years to the Sputnik launch. His interests have been in research in aeronautics and in the related problems of spaceflight. After an introduction, his early life through the college years is reviewed, and his early interest in model airplanes is described. The first assignment for the National Advisory Committee for Aeronautics (NACA), which would later become NASA, was with the Flight Research Division. His early work involved "Flying Qualities", i.e., the stability and control characteristics of an airplane. The next chapter describes his early analytical studies. His work during World War II in the design of military airplanes, and the other effects of the war on research activities, is covered in the next two chapters. This research was involved in such innovations and refinements as the swept wing, the flettner tabs, servo tabs, spring tabs and whirlerons. The rest of the work covers the research which Mr. Hewitt was involved in, after the war until the Sputnik launch. These areas include unsteady lift, measurements of turbulence in the atmosphere, gust alleviation, and lateral response to random turbulence. He was also involved in several investigations of airplane accidents. The last two chapters cover the administration of the Langley Research Center, and the dawn of the Space Age. A complete bibliography of reports written by Mr. Hewitt, is included.
CASI
NASA Programs; Biography; Histories; Aeronautical Engineering

Subject Term Index

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